American Machinist

October 10, 1934

Science and Practice in Metal Cutting

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Dr. Bickel believes that the practical application of data now available rather than new experimentation is the next important step in metal cutting

AS THE QUESTION has been raised (*AM*—Vol. 77, page 782) as to whether the cutting of metals can be made a science, it should be pointed out that this art has been a true science for a long time. It is difficult, however, to put the results of this science into practice in the workshops.

To clear up these difficulties it is necessary, first, to consider the methods and results of the science as developed up to date. Today we see quite clearly that there exist three different "optima" which can be reached when cutting metals, two technical and one economic. This fact has to be thoroughly understood to appreciate the practical difficulties which arise.

The founder of this science, F. W. Taylor, was not able to discern these three "optima" nor to isolate them. When he began his task, "to find the best conditions for cutting metals," it became immediately evident that the task was extremely difficult. He first had to find the conditions on which this optimum depended and which were the variable factors which influenced the forming of a chip. Such a large number of variables were found, such as the quality and form of the tool, speed, depth of cut, tool life, quality of material, form of the piece to be machined, quality of the surface, quality of the coolants and lubrication, that extensive scientific work had to be done, especially in America and Germany, until the influence each of these variables was sufficiently cleaned up to form a general ratio for finding the best conditions by calculating in advance.

When trying first to find a general formula for calculating an optimum, having regard to the majority of the factors, Taylor came to such formulas as shown below.

It is evident that such formulas give no help in practice. If science is to help the workship engineer it should be able to answer, quickly and clearly, such questions as: "What speed, depth and feed shall I use for this job?"; "How can I calculate quickly and easily the piece wage for this job"; and "How can I explain quickly and easily to the workman the conditions for cutting, and how can he easily set his machine to meet these conditions?"

$$v = \frac{\left[1 - \frac{0.72}{r^2}\right]}{[0.0394s]^{0.4 + \frac{2.12}{5+1.26r}} \times \left[\frac{1.5t}{r}\right]^{(0.13 + 0.0675\sqrt{r}) \times \frac{r}{7.35r+1.88t}}}$$

The Taylor method, and all American methods developed along this system, did not penetrate into practice at all.

Only during the post war years was it possible, by scientific research, and after cutting hundreds of tons of material in the different laboratories in Germany and America, to separate the important variables from the non-important ones. In Germany as a practical result of scientific cooperation between production engineers and laboratories of the technical high schools, it was possible to publish books and charts such as "Refamappen, A. F. Richtlinien," "Lehrbucher fur Vorkalkulation," etc.[1] containing complete and well founded tables for speeds, feeds and depth, most

1 Refa-Mappe, Beuth-Verlag G.m.b.H., Berlin SW 19.
A.w.F.-Blätter für Zerspanung, Nr. 100 ff., V.D.I.-Verlag, Berlin SW 7.
Hegner, Lehrbuch der Vorkalkulation, Verlag Julius Springer, Berlin.
Hütte, Taschenbuch für Bertriebsingenieure, Verlag Wilh. Ernst & Sohn, Berlin.
Kronenberg, Grundzüge der Zerspanungslehre, Verlag Julius Springer, Berlin.
(This book deals with most of the practical results reached in the laboratories in different countries. Some of the formulas given here were developed in this volume.)

of them being developed by graphs. Thus the aim sought in the article. "Can the Cutting of Metals Be Made a Science?" in a table was reached in Germany, and the use of tables and charts for practical calculations spread widely in practice.

But achieving this objective it was discovered that the question of best conditions was not solved at all, because it became evident that there exist two different and independent kinds of technical optima for a practical job, the optimum with regard to the tool and the optimum with regard to the machine. It is possible either to reach the tool optimum or to reach the machine optimum. In practice it is a rare occurrence when both optima are reached together. Generally a compromise has to be made for which we have the free choice to select conditions nearer to the optimum for the tool or to the optimum for the machine. This compromise may be called the "general technical optimum" and is not identical with the economical optimum which is the highest aim. To conceive this seeming contradiction it is necessary to consider each optimum separately and to compare them.

The Tool Optimum

Gradually it has become possible to separate the important and the non-important variables for the best conditions for the tool. First it was necessary to eliminate the variable "life of tool" by setting a standard life to form a basis for investigating other variables.

Taylor set the life of tool at twenty minutes. He even tried to prove that he had a good reason for choosing this figure. His argument was that it should be possible to find an optimum between the two variables, speed and cost of changing and grinding the tool. Which is better: To turn with higher speed and to grind often or to turn with moderate speed and grind seldom? He tried to prove by a kind of optimum reckoning, considering costs of grinding, etc., that twenty minutes was the optimum for tool life, but such a calculation has no practical value because

1. Of course, it is possible to find out by experiment the relation between speed and life of the tool, keeping all other conditions constant; for example, the relation may be a function as shown in Fig. 1.

Now it can be assumed that cutting has to be done over a rather long time $T < T_1 < T_2$. When neglecting the loss of cutting time by grinding or changing tools the quantity of chips produced during T will be proportional to the speeds v_1, v_2 and so on, and the cost

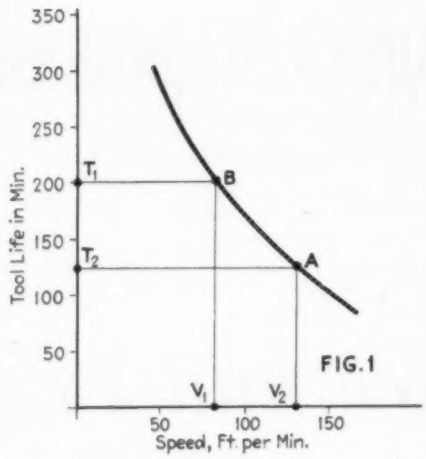


FIG.1

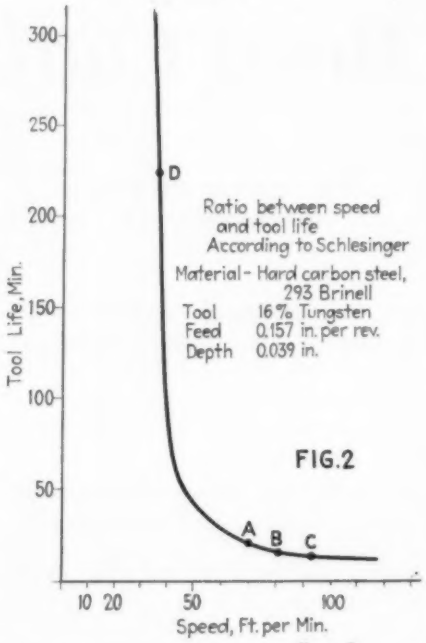


FIG.2

will be proportional to $\frac{1}{v_1}$, $\frac{1}{v_2}$ and so on. The cost of grinding and changing tools may be found as a cer- and so on. The cost of grinding and changing tools may be found as a certain sum for each grinding. This cost arises during the time T, $\frac{T}{T_1} = n_1$ times, when cutting with speed v_1 $\frac{T}{T_2} = n_2$ times, when cutting with speed v_2. By an optimum calculation the optimum may be found, but it is evident that this calculation is right only for one case, that is, when all the other variables have the values maintained for the experiment and calculations. Further, the calculation applies only when T is greater than T_1, T_2, etc. Now in practice conditions are so different that it is not possible to state a general optimum for tool-life by calculation.

2. By the extended experiments of Dr. Schlesinger made in the laboratories of the Technical High School, Berlin, it has been found that the relation between tool life and speed for all kinds of tools and materials have characteristics as shown in Fig. 2.

These Schlesinger curves have been fixed by a wide range of experiments for different tools, materials and feeds.[2] It is evident with regard to the characteristics of the curves that it is dangerous to choose high speeds and short life, as Taylor did, because there is no safety factor in this condition. One would work too near the point where tool life becomes uncertain (see points *A*, *B*, *C*). On the other hand, when choosing moderate speed and long life, as at point *D*, one may be sure that this condition can be fulfilled in the workshop without disaster, as a small alteration of general conditions does not affect tool life seriously since it has become nearly a constant.

Since in practice a large margin must be allowed between the theoretical speed and the practical one, the latter method is to be preferred.

Because the relation between tool life and speed cannot be computed, but must be fixed by common sense the A.D.B. (Association of German Production Engineers) fixed a 60-minute tool life, so all data given in the handbooks and tables mentioned above are based on the 60-minute tool.

Prof. Schlesinger goes further. He proposes a 480-minute tool because of the great improvement in the quality of tools. When considering practical conditions in workshops, using most modern tools but not always the modern machines which are able to take full advantage of the tools, this proposal for the 480-minute tools seems to be quite reasonable.

Having chosen the tool life as a basis the influence of the other variables may be studied.

It was an important discovery that the two variables, feed and depth, can be combined into a single one, the cross-section of the chip. This means that for practical conditions the relation between tool life and speed is practically the same when choosing, for instance, 0.8 mm. feed and 5 mm. depth or 1 mm. feed and 4 mm. depth, the cross-section, 4 sq.mm., being the same.

By this discovery the relation between speed, cross-section and material may be expressed as the "specific speed" reduced to 1 sq.mm. cross-section. When drawing the corresponding curves (found by experiment) in a coordinate system with logarithmic ordinates, it was found that this function always gives straight lines. This means that the relation between speed, cross-section and material can be expressed by the formula

2 Schlesinger, Bearbeitbarkeit und Werkstättenaugnutzung, Zeitschrift des V.D.I., Bd. 76, Nr. 53.

$$v = \frac{C_v}{\sqrt[e]{F}} \quad (1)$$

where v = speed
C_v = specific speed
e = constant for the material

As C_v also depends on the material, the formula can be expressed as follows:

$$v = aF^b \quad (2)$$

where a and b are constants for the material

The next striking discovery was that e has always the same value for all materials of the same class, that is, for all kinds of ordinary carbon steel (mild steel) cast iron, copper, etc. Only C_v depends on the strength of the material. When comparing the simple formula (2) with the early Taylor formula given above it is evident that the science has reached a point where it can help in practice.

For example, in cutting ordinary mild steel with tools of 16 per cent tungsten, the following values are given:

e = 1.94 (basis constant)
C_v = 158 for mild steel of 40 kilo per sq.mm. strength
80 for mild steel of 50 kilo per sq.mm. strength
36 for mild steel of 80 kilo per sq.mm. strength

When using straight tool edges the angles of the tool shape have a relatively small influence. So this variable too could be practically eliminated. The angles have an important influence on the tool pressure and therefore on the optimum reckoning for the machine but not an important one between speed and tool life.

Having simplified the relations between the different variables and reduced them to simple laws, as shown above, it was possible to work out practical tables or graphs for calculating quickly the optimum conditions for the tools. These are all based on the 16 per cent tungsten tool steels. Tools over 18 per cent tungsten, and especially the cobalt tools, permit better conditions, not to mention the cemented carbides. But for these kinds of tools corresponding tables have not yet been completed. In practice, therefore, one has to supplement to these basic values, in accordance with experience.

In many cases machines do not allow full use of the possibilities of these modern tools, so their advantages often lay in longer life only.

This question of machine touches the second point of optimum reckoning for cutting metals.

Machine Optimum

For the tool the cutting capacity is reached when used to the limits of its speed and corresponding cross-section of the chip. For the machine the calculation has to be developed by quite a different method. Here the basis of reckoning is the energy in horsepower. The energy of the machine is consumed in moving the material with the speed v against the tool pressure P. Therefore the energy is

$$N = \frac{P_s}{\text{constant}} \text{ hp.} \quad (3)$$

Each machine tool is able to do a certain maximum amount of work, the limit being set by its construction. When driven by a belt the limit is set by the speed and maximum power of the belt; when driven direct the motor itself gives the limit. The mechanical efficiency as a constant does not affect the principle of the reckoning. The optimum of metal-cutting, with regard to the machine, is reached when the maximum of its energy is used for the work.

Since, in this case, tool pressure has an influence, the laws for this variable had to be found. Similarly to the laws for speed, a great number of variables had to be considered.

As the result of a large number of experiments, the following may be considered as true.

1. Practically the tool pressure does not depend on the speed.

2. It is possible to find "specific tool pressure" P_s reduced to 1 sq.mm. for different materials.

3. Tool pressure depends on the shape of the tool. The ratio was found by a method similar to that used for the ratio between speed and shape. For instance the relation between front rake and specific tool pressure was found as:

$$p_s = 180 \sqrt[1.62]{\frac{\beta}{50}}$$

As β is usually between the limits of 50 and 90 deg. and as it appears under the route, the influence is not great. Nevertheless, it was an important advance that, for different materials, optima for β were found by experiments which are helpful in practice.

4. A strikingly clear relation was found between the specific tool-pressure, strength and Brinnel hardness for different materials.[3] It was possible to express the relations by a simple exponential function, such as,

$$p_s = 31.5 \times H^{-2.2}$$

where H is the Brinell hardness

In this relation the constants are equal for all materials of the same kind, that is, all kinds of carbon-steel, cast iron, etc. Therefore, the strength is the only variable. If the constant for the class of material is known it is possible to calculate the specific tool pressure for a similar material on which experiments have not yet been made. The basic formula is:

$$p_s = a \times H^{-b}$$

a and b being constants for a whole class of materials.

To use the machine to its fullest extent it is possible, therefore, to divide the energy into speed and pressure, to choose the speed and to calculate the section of the chips by dividing the highest possible tool pressure by the specific pressure found for the material by the relation given above.

It would be possible to find for each job the optimum for the machine, but it has to be considered that the chip section found in this way, i.e., via the energy of the machine, has an entirely different relation to the speed as found by the relations for the optimum for the tool.

One cannot expect to obtain the same results in both cases. Indeed it would only be by chance that the results were the same. It is for this reason that the optimum for the tool alone tells nothing about the technical optimum for the job in question.

Joint Technical Optimum

For every machine a range of corresponding values of P and v can be found corresponding to the condition that they form the energy of the machine. In the graphical method the result is a curve corresponding to the law $P = f(v)$ for Pv constant $= N =$ constant. In most practical cases this function will not have a continuous character. Cone pulleys do not allow continuous variations of v, and belt power is not independent of its speeds, but these circumstances do not touch the fundamental side of this optimum reckoning.

As the cross-section $F = f(P)$ is known for a certain material it is possible also to find the curve $v = f(F)$ for a certain machine and a certain material. On the other hand it was possible to find for the tool a curve $v = \phi(F)$ by another relation for the same material.

Both curves have one, and only one, common point which shows the joint optimum for the tool and for the machine when cutting a certain material. As, in both cases, the relations are expressed by exponential functions, the curves when drawn in double logarithmical ordinates are shown as two straight lines. It is not certain that they always cross each other. If they do, a technical optimum is possible, at least theoretically. It may be that it is not possible to work in practice under

[3] Experiments of Klopstock, published in "Berichte des Versuchsfelds für Werkzeugmaschinen an der Techn. Hochschule Berlin, Heft 9.

these conditions; for instance, the chip section may have a value which would be too high considering a rather small depth permitted by the construction of the piece to be machined.

Fig. 3 shows a diagram where conditions are rather good, for a certain material, a certain tool and a certain machine. The straight line a is the tool curve $F = f(v)$; the straight line b is the machine curve, $F = \phi(v)$. The cross point A is the only point which shows the condition for cutting when the tool as well as the machine is used fully, namely when cutting a chip of the section F_1 with a speed v_1. It is possible to cut with a higher speed v_2 and a smaller chip, F_2, but then it is not possible to use the full horsepower of the machine, the point B lying on curve a, which is the limit for the tool. On the other hand it would be possible to cut with a lower speed v_3 and a thicker chip F_3 (point C), but in this case, the tool is not used to its limit because the machine does not allow its full use.

Generally the joint technical optimum is a compromise. Either the optimum for the machine or the optimum for the tool cannot be reached entirely as the cutting conditions of the cross point cannot be fulfilled practically.

In practice conditions are even worse. There are often cases such as shown in Figs. 4 and 5. Fig. 4 shows that the limits are practically governed by the machine only. The tool limit cannot be utilized fully at all. In other words, the tool is too good for the machine. Fig. 5 shows the opposite condition. The machine cannot be utilized to advantage; it is too strong or has too much energy for the tool. At present cases as shown in Fig. 4 are most common in workshops. Modern tools, especially the cutting carbides, have reached such a high standard in recent years that the development of machines has not kept pace. Even if their construction had been equally developed, workshops would not have such machines as it is not possible to modernize machine equipment as quickly as the tools.

To find the optimum conditions quickly there have been prepared in Germany by the A.D.B., the A.W.F. and others, many graphs, even special slide rules and reckoning machines. All these are based on the ratios and cutting laws as described above and are ready for practical use.

There is still another fundamental difficulty to be dealt with. When trying to calculate by the methods shown above it is necessary to calculate every job for a certain machine, and for every machine special curves for the different materials would have to be developed on a special machine card, which must also contain the curves for the tool, the latter being always the same and independent of the machine.

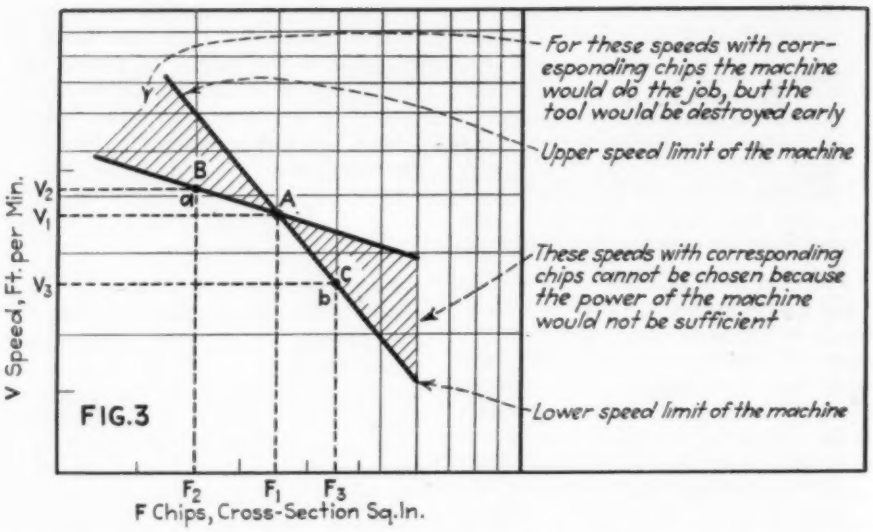


FIG.3

In practice it is difficult to fix in advance the machine for a certain job or the job for a certain machine. Therefore the graphs prepared by the Refa have been developed in such a way that curves for different kinds of machines have been introduced. As there is a direct relation between the horsepower, width of the belt and speed of the belt (horsepower = width × speed × constant), curves for the width of the belt instead of the horsepower have been introduced on the graphs. Fig. 6 shows the scheme of the graphs. Both ordinates are drawn in logarithmic proportion. The graph sheet gives the values for a special class of mateiral, in this case, mild steel, 62,000 lb. per sq.in. strength, and for a special tool, 18 per cent tungsten steel.

The main curve A is the optimum curve for the tool, conforming to the law $v = a \times F^b$ (formula 1). The other curves B_1, B_2, B_3 are put in instead of the horsepower curves, each of them representing a certain width of belt. The horizontal ordinate gives the chip section at the bottom and the belt speed at the top. The vertical ordinate shows the cutting speed at the left and the horsepower necessary for the work at the right.

Calculating can be done as follows:

Without regard to the machine—The curve A gives immediately the relation between speed and chip section, always obtaining the optimum for the tool, or

Considering the machine—The point P has been chosen for cutting. The vertical ordinate belonging to P gives the horsepower necessary for the job. This gives an idea whether the conditions may correspond to the machines where the job might be done. Some other interesting questions can be answered immediately. When following the ordinate of P to the right, the first intersection with a "belt width line" (B_3) gives the width of the belt (point C), and the vertical line erected in C gives the belt speed necessary for getting the horsepower required. Of course, not every belt width is available, and not every belt speed is allowed as belts do proper work with full efficiency only within certain limits of their speeds. Thus the control of belt width and belt speed give an idea whether machines will be found or not for work under such conditions. It may be that the belt speed is outside reasonable limits; it may be that the belt width is outside the practical conditions. If so, another point P has to be chosen until reasonable conditions are found.

Of course the speed and the feed (which can be found easily when knowing the chip section, as the depth is always known by the measures of the rough and finished piece) found by this method has to be made known to the workman. It is a special question of organization how to do this, and another one how to enable the workman to work with his machine as closely as possible to the conditions which were made known to him.

If the machine is selected in advance it is possible to calculate with graphs as shown in Fig. 3. In most cases one has to be content with getting an approximate calculation for the optimum of tool and machine.

Economic Optimum

It would be a false conclusion—although quite natural—to think that the technical optimum when the tool and the machine are utilized fully is identical with the economic optimum. However, it is not so.

The economic optimum is reached when a maximum weight of chips has been produced in a certain time. Whether this quantity has been reached

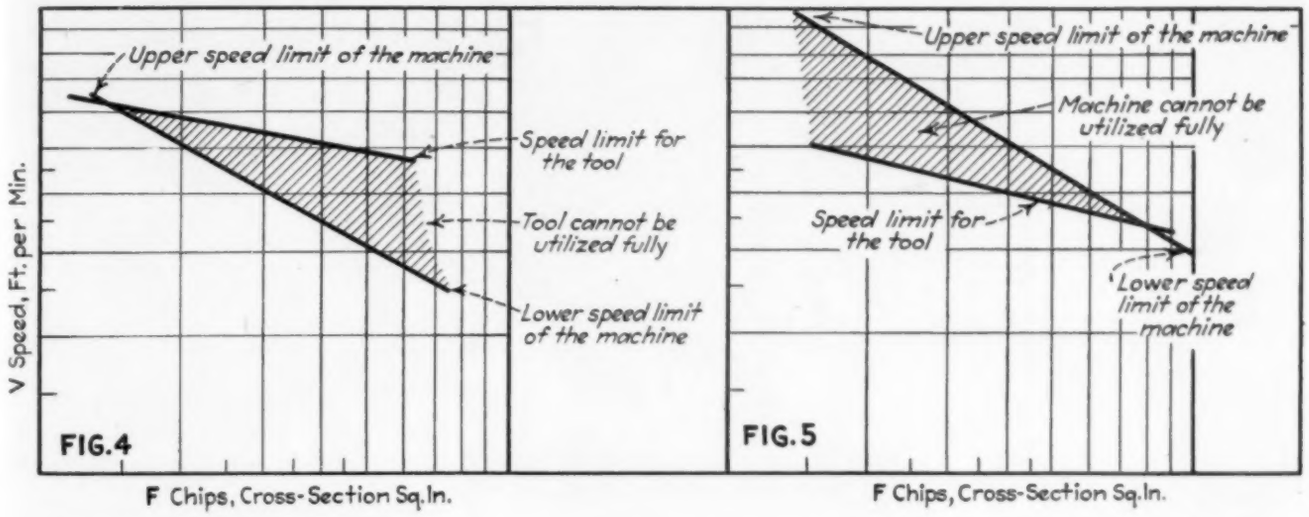

Upper speed limit of the machine
Speed limit for the tool
Tool cannot be utilized fully
Lower speed limit of the machine
V Speed, Ft. per Min.
F Chips, Cross-Section Sq. In.

FIG. 4

Upper speed limit of the machine
Machine cannot be utilized fully
Speed limit for the tool
Lower speed limit of the machine
F Chips, Cross-Section Sq. In.

FIG. 5

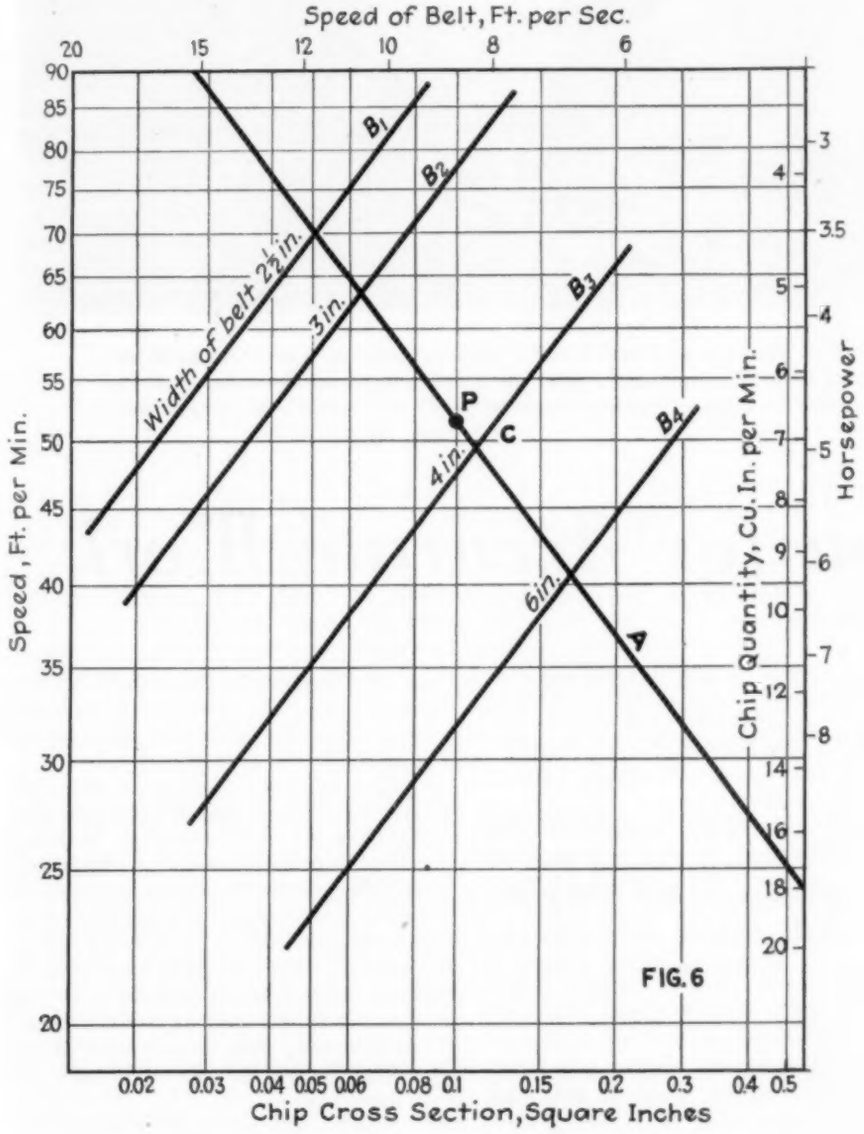


FIG. 6

by high speed and fine feed or by low speed and coarse feed is not of interest at all, but the product of speed times chip section has to be a maximum.

Now F was $f(v)$ for the tool, and as another function F was $\phi(v)$ for the machine. The technical optimum was given as the single case where $F = f(v)$ was identical with $F = \phi(v)$, that is for one certain value for F and v.

The economical optimum is reached when

$$F \times v = \text{maximum}$$

It is evident that only by a chance these values for F and v will be identical with the other ones for the technical optimum. The chance is so rare that it practically does not exist.

The real aim in practice is to cut as much material as possible in a unit of time, to reach an economic optimum, but not to use, tools and machines fully.

There have been developed graphical methods for finding the economic optimum. For instance, in the graphs of the Refa the product of speed times chip section is shown on the vertical ordinate at the right by a special scale.

It is necessary to know the difference between technical and economic optima. Otherwise an entirely false objective might be sought in favoring the side of speed only.

To the question whether metal cutting can be made a science the correct answer is:

Metal cutting cannot only be made a science, but it is already an extensive, complicated, explored and investigated technical science.

To the question, whether or not it is possible to transfer this science into practice, the answer is:

Considering the efforts made up to now, only a small proportion of this science can be transferred to the practice, and even for this small part it is a difficult problem and needs a high standard of workshop organization.

Therefore, the most important task in metal cutting is not to investigate more and more the technological laws for the tools, but to find methods of organization which allow the transfer of the science into the practice.

Mounting bowl-type reflectors on close spacings and low heights obtains lighting from two to three times the intensity provided by the general illumination. Units are 5 ft. apart, 3 ft. above bench tops, and are equipped with 100-watt lamps. Average lighting intensity is 35 footcandles on bench tops

Illumination for Accurate Work

J. J. McLAUGHLIN
Illuminating Engineer
Westinghouse Lamp Company

Local lights supplementing the general lighting give intensities of 300 footcandles and assure easy accurate vision for fine work

HOW MUCH LIGHT does the eye require for best seeing? How much light will save the worker's eyes from the strain and fatigue which, in many instances, are the cause of production waste and needless accidents?

Ideal illumination for best seeing is certainly not the 3, 5, and 8 footcandles found in many plants today, but more like 100 footcandles and better. Considering the eye only—disregarding economics and engineering practicability—intensities on the order of 300 footcandles are necessary to provide the most accurate and comfortable seeing in any kind of fine work.

As a general rule, lighting levels of 100 footcandles or more through the medium of general illumination are not practical. The high intensities, however, can usually be confined to a small restricted working area as on the work bench or lathe. Throughout the remainder of the room good general illumination must be provided, for it is the foundation of correct artificial lighting in the factory interior. Wherever the manufacturing procedure requires close observation of delicate machinery or inspection work, whether for short or long periods, high intensity lighting superimposed on the general illumination will assure the best of vision for the workers.

High intensity lighting on the work may be obtained with floodlight or spotlight units. Mounted high overhead these units can concentrate their rays advantageously on jobs in the working plane, but because of maintenance inconveniences, this method is not always practical. The simpler method is to use local light sources attached to the machine or mounted within arm's reach so that they may be adjusted by the worker to suit his particular seeing requirements.

Small lamps of 25, 40 and 60 watts may be used in these light sources to give the desirable high intensities and at the same time afford economical operation. When placed at distances of from 3 ft. to 6 in. from the work, intensities

A deep-bowl reflector, equipped with a 60-watt lamp and mounted on an adjustable projecting arm, allows the lathe worker to bring high intensity lighting close to his work. More than 200 footcandles are available on the lathe

Adjustable local lighting units on the drill table afford approximately 200 footcandles of high intensity light to assure accurate seeing. The worker's eyes are behind the light source and therefore safe from objectionable, harmful glare

from 50 to as high as 500 footcandles may be obtained. By bringing the light sources close to the work, men can also eliminate practically all disturbing glare, particularly when the lamps and reflectors are mounted on adjustable arms, for then the worker can place the unit so that his eyes are behind the light sources.

Tools for the Eye

To provide workers with local lighting is a commendable practice, but it soon falls short of its goal if neglected. Just as a machinist's work is hampered by dull tools, the quality of work under local lighting will decline through the neglect to replace lamps, or to keep the reflectors clean, or the use of lamps too large for the reflectors. Light sources are tools for the worker's eye and should be kept in the best of condition.

Local lighting with bare lamps is not only bad practice but is also uneconomical. Obviously, more than half the light generated by the lamp radiates away from the working plane and is, therefore, wasted.

It goes without saying that a bare lamp source provides the worst kind of glare. Every bare lamp should be protected with a reflector that minimizes the glare and recaptures the wasted light. In this way illumination is controlled usefully and directed to the working plane where it is needed. A reflector increases the illumination on the work by 20 to 30 per cent.

Another common fault seen in local lighting installations is the use of incorrect lamp sizes in reflectors. If the lamp is too large it will extend beyond the mouth of the reflector, still causing glare and wasting light. The lamp may give sufficient light for the work but the reflector is too small to control it properly.

For example, in one instance where the light source was mounted 10 in. away from the work a 50-watt lamp was found in a reflector that was too small. The bulb projected below the opening of the reflector, and of course light was wasted. The intensity on the working plane was only 120 footcandles. By replacing this reflector with a larger one, the intensity on the work was increased to 169 footcandles.

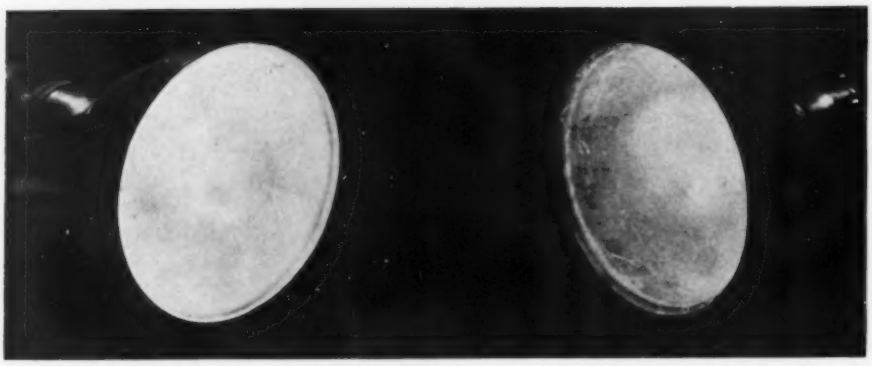
In another instance, where the light source was again 10 in. from the work, a 60-watt lamp was used in a reflector which was too small. The intensity on the working plane was 154 footcandles. By replacing the reflector with one of proper size the intensity jumped to 224 footcandles, or an increase of 45 per cent.

The shape or contour of the bowl reflectors for local lighting is designed to produce a definite distribution of light. The size of reflector is determined by the wattage of the lamp which gives the required intensity of light. When both are in correct relationship, the light center will be in such a position as to give the best possible distribution of light at maximum efficiency with a minimum of glare.

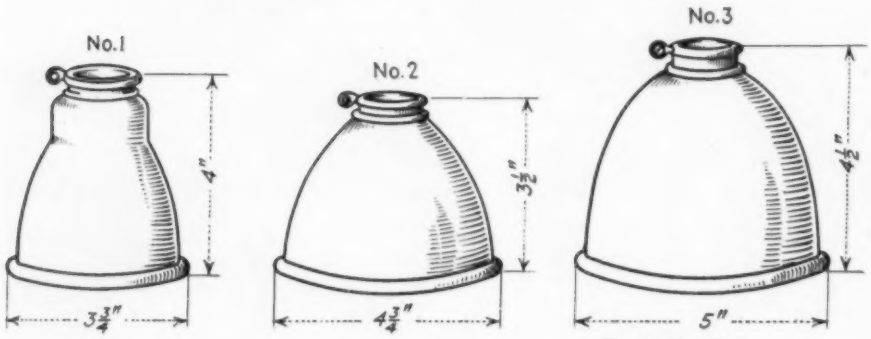
Reflector Sizes

There are three general sizes of bowl reflectors available for local lighting purposes. All three are of porcelain enamel finish, green outside and white inside.

The size of reflector selected depends upon the character of the work to be



To neglect the care of a worker's light is the same as giving him dull tools. Note the difference in these two local lighting units found adjacent to each other on a factory work bench. Merely cleaning the reflector and inserting a new lamp resulted in 50 per cent more light



Kind and Size of Lamp				Reflector Size	Foot-Candles at Distance from Work	
Watts	Volts	Bulb	Finish		5 in.	10 in.
15	115	A-17	I.F.	1	110	30
25	115	A-19	I.F.	2	222	65
40	115	A-19	I.F.	2	354	110
50 R.S.	115	A-19	I.F.	2	342	110
50	115	A-21	I.F.	3	428	169
60	115	A-21	I.F.	3	592	224

A guide to the selection of local lighting equipment shows the correct lamp and its corresponding reflector size to give the highest intensity on the working plane

illuminated. For the lighting of lathes and most one-operator machinery, the small reflector will usually prove satisfactory. In such cases, the reflector may be mounted on an adjustable arm so that it can be moved to and from the work as seeing conditions demand. Where the work is of such nature as to require higher intensity or a good intensity over a wider area, the larger reflector is suggested because it permits the use of a larger lamp. This reflector is also recommended for the fixed installation.

Often it is desirable to obtain a high level of illumination over a long row of work benches, or inspection tables, which cannot effectively be lighted to proper intensity from the general lighting installation. In such instances, the larger of the bowl reflectors can be installed on close spacings at low mounting heights. In this way it is possible to provide on the working plane intensities of 30 to 60 footcandles or from two to three times the level produced by the usual general illumination system. Each individual reflector in such an installation may have its own control switch.

General Lighting Plus

The advocation of local lighting is not to be viewed as a return to the methods of years ago when many factory interiors were a maze of drop cords and bare lamps, suspended above machines and work benches without a thought to uniformity of illumination or seeing of the workers. Progress in factory illumination throughout the years decreed a right-about-face to general lighting as the initial step. Now that factories have come to accept the wisdom of good general lighting, the next logical step is the adoption of general lighting plus, or the use of high intensity lighting superimposed so that footcandle intensities of 100 and better are available for all workers whose seeing requirements demand them.

The new school of lighting looks to the specific needs of the eyes in industry. A blending of general with local lighting seems to be the best way to meet these needs. Sometimes general lighting of 10 to 20 footcandles will suffice for rough work, as in shipping and hand truck traffic, and for general movement on manufacturing floors. When, however, the worker must keep his eyes riveted for long periods on a fine piece of lathe turning, or on a delicate assembly job, or in rigid inspection procedure, only good local lighting will permit him to see accurately. Aside from providing conditions for comfortable vision under which high labor efficiency may be maintained, the employer definitely fulfills an humanitarian obligation when he places his stamp of approval on a lighting system that carries out modern practices to the letter.

Power Economy in the Machine

JOHN E. HYLER

Among the many factors which must be watched in designing and building a machine to make it appeal to the shrewd buyer of today, power economy is one that dare not be neglected. There are times when a machine will be needed to handle certain rather complicated work, requiring the operation of a number of heads or cutting units, and yet it is desirable that the machine may be used for much simpler work. Means of reducing the power consumption on the lighter work is usually not hard to furnish, but sometimes it offers considerable of a problem. Where all drives are electric, the individual motor system, possibly of the interlocked type, is the logical answer.

In a machine designed for boring holes at right angles to each other in castings for agricultural equipment, the base is made up of three pieces bolted and doweled in the form of a cross, with a work fixture at the center and a multiple drill head on each of the four legs of the cross to provide four-way boring. It was found worth while to arrange the feed in such manner that each set of opposed heads could be fed by a separate hydraulic pump. In this manner, either set of opposed heads may be not only cut out of service when desired, but the power required to operate them is saved by running only one pump.

Price-Performance Basis for Navy Purchases

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and

F. C. NICHOLS
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Acceptance of the lowest bid is not always in the public interest. The procedure for cold chisels shows how the Navy applies the performance factor in buying

PRIMARILY the Navy is required to purchase from the bidder offering the lowest price, the only proviso being that such a bidder must establish to the Department's satisfaction that he is the manufacturer of a reasonably good product. The practice does not guarantee that the Navy will receive the most service per dollar expended of the public's money, and a logical trend is toward purchasing on a price-performance basis. At least a start has been made as described in the following example.

Some time ago the Navy Department decided to investigate the relative cutting efficiency of the various commercial makes and brands of metalworkers' chisels. This was done to arrange future purchases of this product on the price-performance basis if the investigation indicated that such a course would be of material benefit. In undertaking the investigation all chisel manufacturers of which the Department had record were invited to participate in a competitive evaluation test free of charge, aside from furnishing the necessary test samples. Each participant was required to furnish a set of three samples of each brand of steel to be tested. The samples were required to be ¾-in. octagon, about 8 in. long, one end to be left blank and the other end to have a hex-round shank to fit Navy standard pneumatic chipping hammer bushings. The chemical composition of the steel and the heat-treatment to be employed were left entirely to each manufacturer.

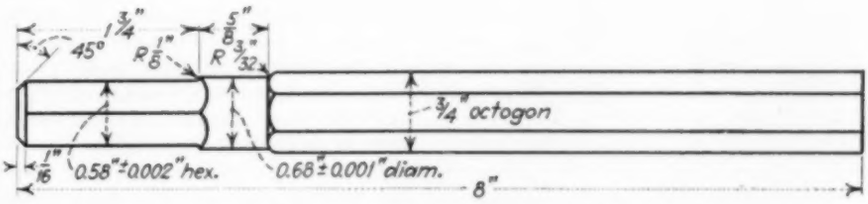
Sample Tool

When the tests were started the blank end of each sample was forged to chisel shape, carefully heat-treated in accordance with the directions supplied by the manufacturer and ground to a standard gage. These sample tools in the form of pneumatic chipping chisels were then used with a commercial, standard-size pneumatic chipping hammer to remove chips ⅛ in. in thickness from the edge of a specilly treated steel plate having a Brinell hardness of 190-210. Each sample chisel was run until it failed due to chipping or breakage, or because the cutting edge became so dull as to be no longer serviceable without regrinding. The chips were carefully collected and weighed, and the average weight in grams of chips removed by a set of three sample tools was declared and assigned as the "work value" for the brand represented.

Every reasonable precaution was taken to maintain uniform conditions for all the tests and to reduce the personal element to a minimum. The test plates were carefully checked and treated to provide uniformity. Tests with hand hammers were ruled out as likely to produce undesirable variations due to the human element. The pneumatic chipping hammer employed in the tests was carefully guided by an operator to remove chips of uniform thickness, and the air supply was maintained at a fixed pressure. The personal element was necessarily involved in deciding when the chisel had become dull. Every care was taken, however, to see that all manufacturers fared alike.

It was discovered that chisels purchased heretofore on the low-price basis (usually of straight-carbon steel) would remove less than 1,000 grams of chips, whereas under identical conditions other brands (of alloy steels) would remove 8,000 or more grams. The results also showed that changes in the heat-treatment of alloy chisel steels caused a profound change in the performance of the chisels, the differential at times being 100 per cent or more. The tests further showed that if the best test results were to be reflected in everyday service it would be imperative that each Navy heat-treating activity have modern equipment, and in addition accurate data applying to the proper treatment of each brand of chisels with which they might be supplied. The latter is particularly important inasmuch as Navy purchases cannot be restricted to any one brand. Furthermore, there is sufficient variance in the heat-treatment of the various brands to warrant careful attention to the individual brands in order to obtain the desired results.

Incident to the tests, it was found that the manufacturers of alloy chisel steels employ with one exception the various alloying elements commonly used in the manufacture of various types of alloy steels. Chromium, except for accidental inclusions, was noticeably absent in the steel of all brands attaining the higher work



Pneumatic scaling chisel blank, Type B, supplied by each bidder for test to determine "Work Value" of his products

values. Hardness values productive of the best results were found to be about 58.5 for the chisel end and 45 to 50 for the shank end (all values Rockwell C scale 150 kg. load). A large percentage of failures were caused apparently by fatigue in the metal, the cutting edges of the chisels chipping or breaking. This applied likewise to brands attaining the higher work values. There were some instances, however, in which all three samples of a brand failed solely because of dulling of the cutting edges.

At the present time 78 tests have been conducted on various brands of chisel steels with the following results:

3 Brands removed in excess of 13,000 grams.

1 Brand removed between 12,000 and 13,000 grams.

2 Brands removed between 11,000 and 12,000 grams.

1 Brand removed between 10,000 and 11,000 grams.

2 Brands removed between 9,000 and 10,000 grams.

4 Brands removed between 8,000 and 9,000 grams.

4 Brands removed between 7,000 and 8,000 grams.

5 Brands removed between 6,000 and 7,000 grams.

8 Brands removed between 5,000 and 6,000 grams.

9 Brands removed between 4,000 and 5,000 grams.

8 Brands removed between 3,000 and 4,000 grams.

11 Brands removed between 2,000 and 3,000 grams.

9 Brands removed between 1,000 and 2,000 grams.

8 Brands removed between 500 and 1,000 grams.

2 Brands removed less than 500 grams.

Inasmuch as the foregoing performance differentials were found to exceed the maximum market price differential (about 40 per cent) for the various brands of chisels, no time was lost in deciding that the Navy would benefit greatly in adopting the price-performance method of purchasing the product in question.

Large Savings

Although it would be impracticable to estimate with any degree of accuracy the savings resulting from the price-performance method of purchasing chisels for an institution of the magnitude of the Navy, it is a known fact that the savings have been considerable. The volume of chisels in service requiring redressing, heat-treating and grinding has been sharply curtailed. Additional savings result from a longer wearing life of the cutting edges, particularly in those trades which use chisels continuously

To provide the Navy heat-treating activities with appropriate instructions applying to the respective brands of chisels each tool is required to be stamped on the body with the heating and drawing temperatures and with the quenching medium; for example, "1600—oil—450." These data are employed in the subsequent heat-treatment of the respective brand of tools. Despite predictions to the contrary these markings have caused little or no difficulty due to tool breakage at the location where the markings are applied.

Hand and pneumatic chisels of numerous styles and sizes are regularly carried as standard stock at various Navy activities. These stocks are replenished semi-annually, the potential requirements for the ensuing six months' period being based on past issues. Prior to the stock replenishment period, the various Navy activities submit a request or requisition to the Bureau of Supplies and Accounts, giving the quantity, types and sizes of tools required. These requests or requisitions are checked against any excess stock which may have been reported at other stocking centers. They are then checked for technical accuracy after which the purchasing Bureau prepares and issues a schedule advertising for bids, a copy of which is sent direct to all prospective bidders. The schedule gives the styles, sizes and types of tools required by each activity and the date and time on which the bids are to be opened.

Basis for Contract Award

When the bids are opened, each bidder's price is divided by his work value, and the lowest bidder is adjudged to be the one obtaining the lowest figure under this computation, regardless of how much higher his total bid price might be as compared with that of competing bidders. In computing the bids the work value of any one brand of tools is made to apply to all sizes and styles of hand and pneumatic chisels of that brand. However all such tools must be made from the same quality of steel as that used in the manufacture of the test samples. Proposed deliveries are carefully checked at the time of inspection to determine compliance with this requirement, and also to determine whether the tools have been properly hardened and tempered to show Rockwell hardness numbers comparable with the test samples.

In order to protect the interests of the various manufacturers as a whole, detailed results of the tests herein described are available only to the Naval Service. Each manufacturer is privileged to witness the test on his product and is informed only as to the results obtained by the brand or brands which he submitted for test. The initial tests incident to establishing a list of prospective bidders were conducted without charge to the manufacturers. However, manufacturers are now required to bear the expense of such additional tests as they may be interested in having conducted in an effort to improve their existing work values.

Checking the NRA Discussion

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Forbes & Myers

The recent questionnaire by the New England Council produced some valuable statistics, some of which were mentioned in the editorial (*AM*—Vol. 78, page 508a). But there remain many doubts as to just what these answers signify.

In the case of the minimum wage, while the larger number of replies were to the effect that it was helpful, it should be noted that this larger number was but 44 per cent. 29 per cent voted that it was of no effect. It should also be observed that the vote was taken in New England where the cheap labor of the South is feared. It may be that much of this vote was the belief that it enabled them to get business away from Southern mills. To the extent that the gain was made at the expense of others it should be discounted.

The overwhelming vote that the famous Section 7(a) had no effect is no surprise to those who know New England business. In my experience the question of collective bargaining has never been raised. The few big fights over this issue attract attention, but they do not affect the mass of business organizations. In the twenty years that I have been in business, I have never heard of the issue of collective bargaining being raised in any plant within the radius of the thirty or forty nearest companies.

Taking the answers as a whole, there is a slight preference for the view that codes are beneficial, but no effect is the dominant reply. The opposition nearly equals the favorable votes. The vote was quite plain that business wanted some kind of a code, but this some kind was also plainly not the NRA kind. The next question that needs study is what industry really wants. I suspect that there will be about as many wants as individuals, and very much doubt if any codes can be found that would prove generally acceptable.

MAGNESIUM for LIGHT-WEIGHT JIGS

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Aluminum Company of America

Easier handling often compensates for the higher initial costs involved in the use of a light-weight material

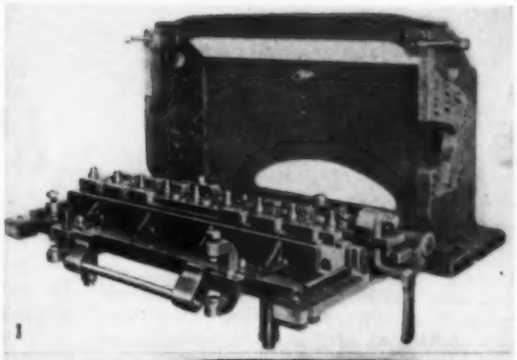
A SUITABLY built jig must be easy to handle so as to reduce to a minimum the time necessary for exchanging the work and consequently the no-load time of the machine. Since many automobile parts which have to be machined are bulky, as for instance, crankcases, gear cases and cylinder blocks, the fixtures for machining these parts are of large size. This is a serious disadvantage as their weight makes it difficult to mount and to dismount them as well as to operate the movable parts of the fixtures quickly. The increased load on the machine and the greater power consumption of mechanically operated fixtures is objectionable. Finally, it must be remembered that the operator has to use more time and energy in handling a heavy fixture, and this increases the operating time per piece.

For these reasons the weight of fixtures should be kept as low as possible. The use of magnesium alloy castings lends itself particularly towards accomplishing this result. Leading automobile manufacturers in Europe have realized the usefulness of magnesium alloy in the building of fixtures, and during the last few years have been using it wherever a reduction of weight was required.

It is, of course, necessary to take into consideration the characteristic properties of magnesium alloy when using it in a mechanical design, and no excessive demands should be made upon it with respect to wear. Such parts as drill bushings, guide rails, stops and the like should be protected with steel, and if the fixture is to undergo considerable handling in use the corners should be steel reinforced.

The accompanying illustrations show a number of drill jigs where magnesium alloy has been successfully used. Fig. 1, shows a jig for drilling 134 holes in an 8-cylinder magnesium alloy crankcase. The hinged lid, which is moved during the operation, is a magnesium casting while the drill bushings, stops and guide rails are made of steel or covered with steel plates. The hinged lid is about 35 in. long and 22 in. wide. The light weight is evident when one realizes that one man is easily able to open and close the magnesium lid even with the work in place. Figs. 2 and 3 show the jig with the work in place, in the open and closed position. Figs. 4 and 5 illustrate other fixtures developed on the same principle.

Occasionally the objection is raised that the use of magnesium alloy may represent an increase in the cost of the fixtures. The answer to this objection is that the cost of machining magnesium parts is low thus tending to offset a higher cost of raw material. The extent to which this difference in cost is offset depends on the amount of machining to be done on the part in question. In some cases, however, it will not be possible to avoid an additional outlay for fixtures made of magnesium as compared with those of steel. Notwithstanding, a possible increase in first cost when using magnesium castings, they will, in many applications, be found advantageous and to lead to savings which in a relatively short time more than offset the additional first cost.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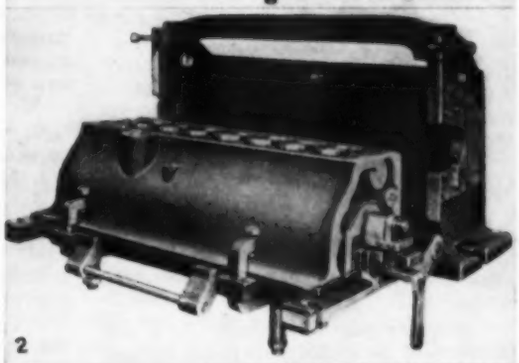
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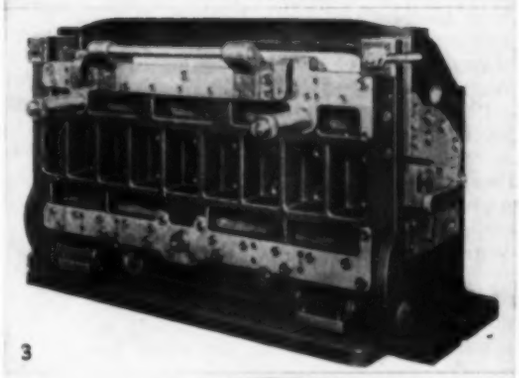
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Production Experience

E. S. CHAPMAN
Amplex Division,
Chrysler Motor Corporation

Three examples record complete data concerning work, machine equipment and broach cost per piece

A steering gear cross-shaft has a slot that would be difficult to finish by any other method than broaching.

MATERIAL • SAE 4130 heat-treated forging weighing 3 lb. Heat-treatment —1,550 F., water quench, draw 3.7-4.10 Brinell.

DESCRIPTION • Upset forging having approximately a 2 in. diameter knob on one end, this knob being slotted or indented in the forging operation.

CONDITION • Because of location of the slot in the forging, the cold-trimming is a difficult operation, and the stock to be removed by broaching varies considerably.

OPERATION • This slot must be broached smooth on the sides and a V-shaped clearance broached at the bottom of the slot.

LIMITS • The sides of the slot must be parallel and be within 0.002 in for width —1.031/1.033 in.

STOCK REMOVAL • Approximately $\frac{3}{64}$ in. is broached from each side which is $1\frac{5}{8}$ in. long by 1 in. wide.

EQUIPMENT • A duplex vertical broaching machine (mechanical) with two rams is employed.

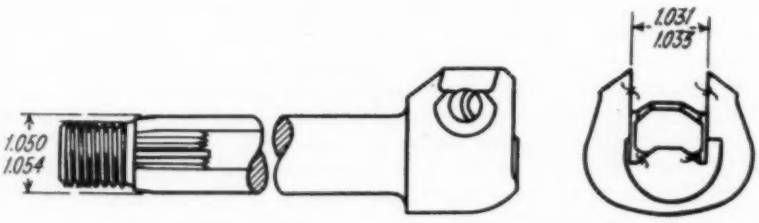
FIXTURE • Tilting type. The part locates in a bushing against a turned and ground shoulder and is located sideways by equalizing jaws on the sides of the upset head to divide the stock properly.

BROACH • Four broaches are used per set-up, each approximately 8 in. long, making one broach 32 in. long. The broach speed is 27 ft. per min.

PRODUCTION • 125 parts per hr.

BROACH COST • This type of broach has only 0.001 in. grinding stock on the width, but can be sharpened by grinding approximately 0.005 in. from the face.

The available broach life is 0.050 in. on the face and about 10,000 pieces are finished per grind. Average broach cost per piece in this case is $0.00125. Broaches have runs over 140 hr., or about 20,000 pieces, without removal for grinding.



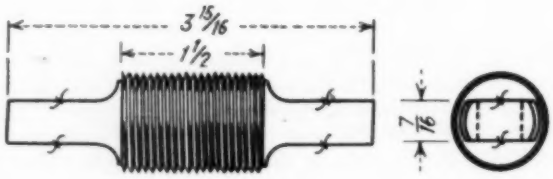
* * * *

MATERIAL • SAE 1335 with no heat-treatment before broaching. The weight of the blank is about 1 lb.

DESCRIPTION • Four flat surfaces, two at each end, must be held closely parallel and in plane with each other and closely parallel to the pitch-line plane of the threaded center section. The piece is threaded at the center portion for approximately $1\frac{1}{2}$ in. and with $1\frac{3}{16}$ in. at each end turned to $\frac{13}{16}$ in. diameter.

LIMITS • Thickness of flats 0.430/0.444 in.—±0.007 in. Flats must be in the same plane within 0.005 in. and parallel with threads within 0.001 in. per inch.

STOCK REMOVAL • Over $\frac{3}{16}$ in. stock is removed on each side at the maximum diameter.



EQUIPMENT • Two vertical double broaching machines mechanically operated.

FIXTURE AND OPERATION • The part is clamped between cam-operated jaws having threaded inserts that bear on the pitch diameter of the thread. The machine slide has two broaches so two pieces at a time are broached. The fixture is stationary, and consequently after the slide goes down it is stopped until the work is removed.

BROACH • Broach details are 14 in. long, approximately $1\frac{1}{2}$ in. wide and 1 in. thick and are made of high-speed steel. Eight details are required for setting up the complete machine on both sides. Broach speed is 30 ft. per min.

PRODUCTION • 179 parts per hour per machine.

BROACH COST • The available broach life is 0.080 in., about 0.005 in. being removed per grind, giving a total of 16 grinds. In spite of the amount of stock to be removed, about 9,000 pieces are finished between grinds, and the average present cost of broaches is $0.0019 per piece.

Abstracted from a paper presented at the Production Meeting, Society of Automotive Engineers, October 10, at Detroit.

with Surface Broaching

Two broaching operations are performed on the wishbone-shaped forging known as the front-wheel control arm. The forging has legs approximately 20 in. long, one boss at the center and one boss at the end of each leg.

MATERIAL • SAE 3135 heat-treated forging weighing 14 lb. Heat-treatment —1,550 F.—oil quench—draw to 3.8-4.00 Brinell.

CONDITION • Forgings are made with the die split in the center. This introduces some mismatching and shifting of the forgings and also flash completely around the centerline.

FIRST BROACHING OPERATION • The first operation consists of broaching the four sides of the leg bosses. In addition, a flat slot is broached in the end of each boss for locating purposes. Considerable variation in the amount of stock is encountered.

LIMITS • Thicknesses of bosses—1.368/1.382 or ±0.007 in. Width between bosses inside—12.618/12.642 or ±0.012 in.

STOCK REMOVAL • From $\frac{3}{32}$ to $\frac{1}{8}$ in. is broached from each of the four faces, each of which is $1\frac{3}{4}$ in. in diameter.

EQUIPMENT • Three machines are utilized for the first broaching operation as follows: one vertical mechanically operated type and two 25-ton vertical hydraulic units. These are single-row machines, broaching two bosses on one part at a time.

FIXTURE AND OPERATION • The part sets in the fixture and is located on the bosses for length. An equalizer clamps the center boss and air clamps are used on the end bosses. The fixture tilts for loading and unloading and to allow the broach slide to return.

BROACH • The broach details are 2 in. wide, $1\frac{1}{2}$ in. thick and 36 in. long and are made of high-speed steel. Broach speed is 44 ft. per min.

PRODUCTION • Parts per hour, 111 per machine.

BROACH COST • The broach cost per piece on this operation averaged $0.0023 at the end of the period. The broach life was about 0.250 in., and about 0.010 in. per grind was removed with 5,000 pieces produced between grindings. No comparison with milling cutter costs can be given on this job because the only milling set-up in use was elementary.

SECOND BROACHING OPERATION • The second operation is the inside face of the center boss.

LIMITS • Width of boss—1.140/1.109, or 0.031 in.

STOCK REMOVAL • From $\frac{3}{32}$ to $\frac{1}{8}$ in. is removed from the back of the $1\frac{1}{8}$ in. diameter boss.

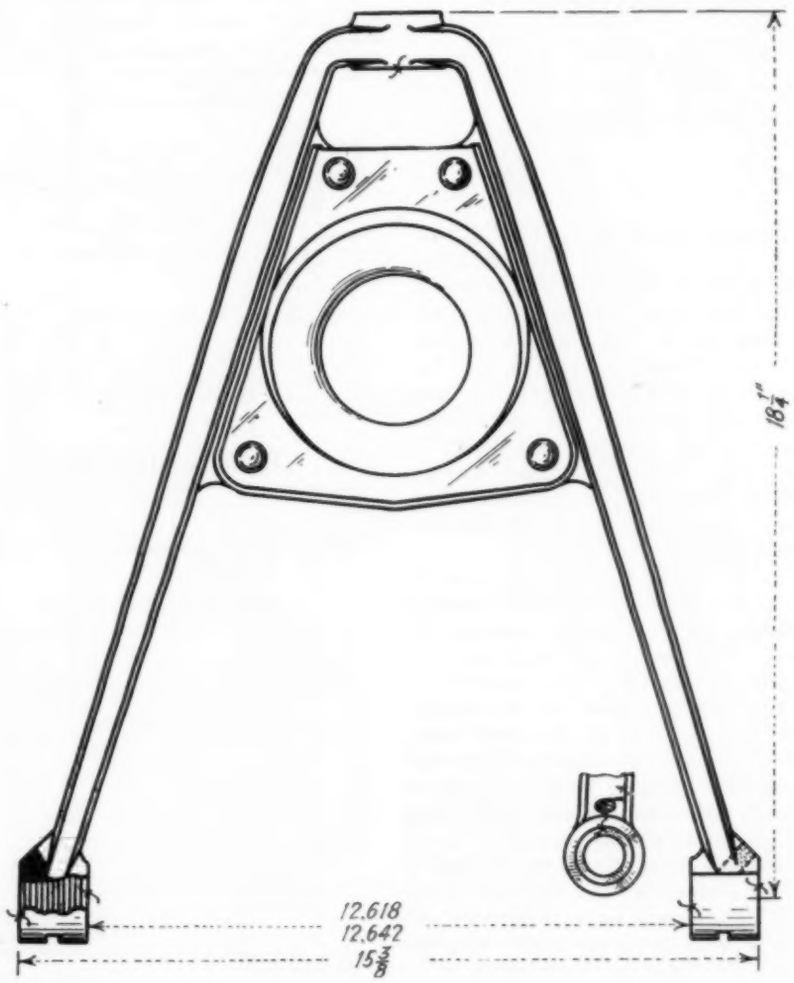
EQUIPMENT • There are two 25-ton vertical hydraulic broaching machines on this job, both of the single-ram type, broaching one part at a time.

FIXTURE • Part sets horizontally in the fixture with outside of leg bosses against the side stops, and cone plugs inserted in the boss holes from inside to locate for length.

BROACH • One broach detail is required per machine. It is 46 in. long, $2\frac{1}{8}$ in. wide and approximately $1\frac{1}{4}$ in. thick, and made of high-speed steel. Broach speed is 44 ft. per min.

PRODUCTION • Parts per hour, 111 per machine.

BROACH COST • Average cost per piece on this operation is $0.0023. The broach life is 0.0625 in. Fewer broaches are required for set up than in the first operation, but the shorter total life accounts for a nearly equal broach cost per piece. This operation is a good example of the possibility of broaching surfaces almost impossible to mill on a production basis because there is insufficient room for a milling cutter or arbor and about the only alternative would be a back spot-face operation.



What Do Jigs and Fixtures Cost?

Practical examples from the files of a tool shop furnish a check on costs and help in estimating new work

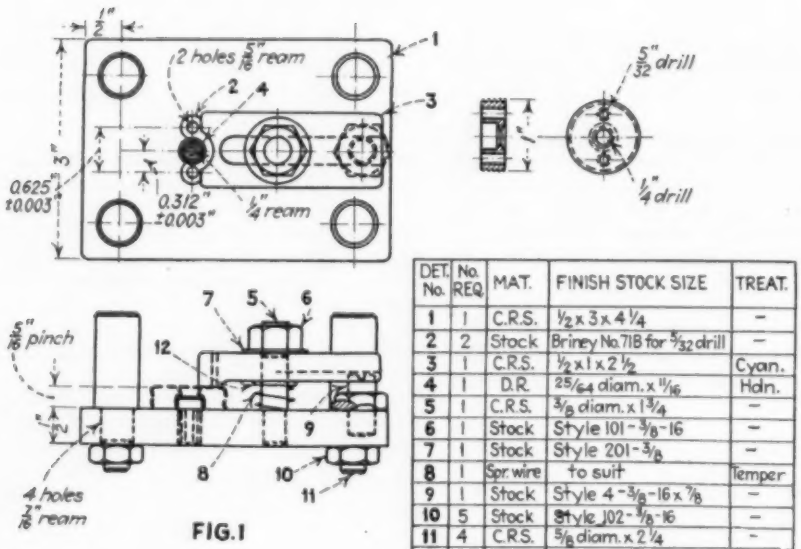


FIG. 1

DET. No.	No. REQ.	MAT.	FINISH STOCK SIZE	TREAT.
1	1	C.R.S.	1/2 x 3 x 4 1/4	–
2	2	Stock	Briney No. 71B for 5/32 drill	–
3	1	C.R.S.	1/2 x 1 x 2 1/2	Cyan.
4	1	D.R.	25/64 diam. x 11/16	Hdn.
5	1	C.R.S.	3/8 diam. x 1 3/4	–
6	1	Stock	Style 101 - 3/8 - 16	–
7	1	Stock	Style 201 - 3/8	–
8	1	Spr. wire	to suit	Temper
9	1	Stock	Style 4 - 3/8 - 16 x 7/8	–
10	5	Stock	Style J02 - 7/8 - 16	–
11	4	C.R.S.	5/8 diam. x 2 1/4	–
12	1	Stock	Style 201 - 3/8 (alt. to 5/8 O.D.	–

JIGS and fixtures play an important part in modern industy, both from the viewpoint of cost and of duplication of parts. In many cases duplication and accuracy are the deciding factors rather than lowered production costs. In every instance, however, the cost of the jigs and fixtures is an important item, especially when it must be borne by a comparatively small output.

In order to arrive at a basis on which the cost of jigs and fixtures can be accurately estimated, a number of examples are given from the Taft-Peirce Manufacturing Company, whose years of experience on a great variety of work in this line make their experience of especial value. These examples are taken from their files and cover a sufficiently wide range to assist shop managers and toolmakers in many lines to check up on their own costs. Or the information given can be used in estimating the cost of future jigs and fixtures for new work as it comes along.

A simple drill jig for drilling two 5/32-in. holes in a piece held by a single toe clamp is shown in Fig. 1. The base *1*, 3 x 4¼ in., is of cold-rolled stock, as is the clamp *3*, which is slotted for the hold down bolt and grooved for the guide pin *9*. The clamp is cyanide hardened. Detail *4*, which locates the piece to be drilled, is of drill rod, hardened and ground. The dimensions, tolerances and materials are shown in each case. Drill bushings, springs, washers and nuts are from standard stock. The time allowed and the cost of material is given in Table I.

The drill jig in Fig. *2* is not as simple as the first because it involves making a pattern for which eight hours are allowed. The work is seen at *A* and also in place in the jig. It is centered by its large end positioned by the angular V-block *4*, and held by the strap clamp *13*. Two small holes are drilled in the flange, the bushings being seen at *16*. A small hole is also drilled in the small end at *7*, and a cross hole at *5*. Both the bushing cover *17* and the V-block *4*, are of cold-rolled steel, cyanide hardened. They are pivoted on pins *14* and *15*, the ends of the pin holes being enlarged for ease in assembling. The schedule of time allowance for the different parts and the material cost, is given in Table II.

Fig. *3* shows a pot fixture with a base that bolts to a lathe or boring mill face plate; the work is shown by heavy dotted lines. It is located on the central plug and also by the step bearing at the shoulder. The corner of this shoulder is relieved as shown. The work is held by three finger clamps. The construction is simple; the base *8* is of cast iron, seven hours being allowed for

Table I—Drill Jig

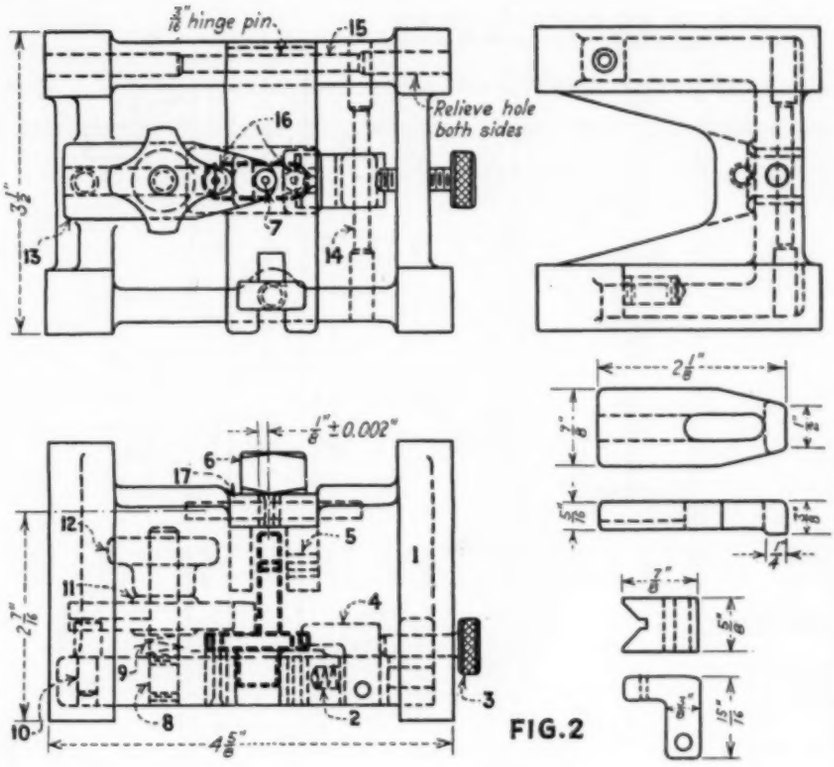
Req'd	Part	Time Allowed Hours	Material Cost
	Cut off material	.80	.....
1	No. 1 { Boring Dept.	2.50	.....
	No. 1 { Tool Room	3.20	.10
2	No. 2*	1.00	1.50
1	No. 3	3.00	.05
1	No. 4	1.50	.02
1	No. 5	.75	.02
1	No. 6	.....	.04
1	No. 7	.....	.10
1	No. 8	.75	.02
1	No. 9	.....	.05
5	No. 10	.....	.18
4	No. 11	3.00	.08
1	No. 12	.....	.10
	Hardening	1.0	.....
	Assemble	2.50	.....
	Inspect	1.00	.....
		21.00 hrs.	$2.26

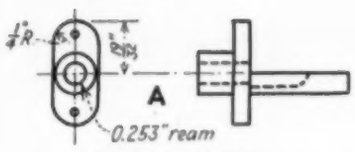
*Part No. 2 is a standard bushing. The time allowance is for grinding the outside diameter to suit the bored hole.

Table II—Drill Jig

Req'd	Part	Time Allowed Hours*	Material Cost
	Cut off material	1.0	.....
1	No. 1 { Grind Dept.	4.0	.....
	No. 1 { Boring Dept.	5.0	.....
	No. 1 { Tool Room	5.0	.30
1	No. 2	.5	.02
1	No. 3	1.0	.02
1	No. 4	3.5	.03
1	No. 5	1.0	.05
1	No. 6	1.5	.05
1	No. 7	1.0	.05
1	No. 8	1.0	.02
1	No. 9	.5	.02
1	No. 10	.7	.02
2	No. 11	.....	.10
1	No. 12	.75	.05
1	No. 13	2.50	.05
1	No. 14	.50	.05
1	No. 15		
2	No. 16	2.3	.05
1	No. 17	4.0	.15
	Hardening	1.2	.....
	Assemble	2.5	.....
	Inspect	2.0	.....
		41.45 hrs.	$1.03

*Pattern—8 hr.





Jack Spring Post
No. 2 Brass

FIG. 2

DET. NO.	NO. REQ.	MAT.	FINISH STOCK SIZE	TREAT
1	1	C.I.	Patt.	
2	1	M.W.	To suit	
3	1	C.R.S.	1/4 diam. x 1 1/8 lg.	Cyan.
4	1	C.R.S.	3/8 x 3/8 x 1 3/16	Cyan.
5	1	T.S.	1/4 diam. x 3/8	H.-G.
6	1	C.R.S.	1/4 x 1/2 x 1 1/8	C.R.S.
7	1	T.S.	1/4 diam. x 3/8	H.-G.
8	1	C.R.S.	1/4 diam. x 2 1/2 lg.	
9	1	M.W.	To suit	
10	1	C.R.S.	1/4 diam. x 1/2 lg.	Cyan.
11	2	STK	Sty. 201, 1/4 x 1/2	
12	1	STK	Sty. 324, 1 1/4, tap 1/4-18.	
13	1	C.R.S.	1/2 x 1/2 x 2 5/8	Cyan.
14	1	D.R.	1/4 diam. x 1 1/8 lg.	
15	1	D.R.	1/4 diam. x 2 lg.	
16	2	T.S.	1/4 diam. x 1/2 lg.	H.G.
17	1	C.R.S.	1/8 x 1 x 3 5/8	Cyan.

the pattern; detail *7* is of 9/16-in. drill rod, hardened and ground. Clamp *6* is of cold rolled steel, cyanide hardened, stud *2*, headless set screw *1*, and nuts are standard. Spring *5* is wound to suit stud. The allowed time is given in Table III.

An interesting templet, carrying ten standard and two special drill bushings

Table III—Fixture

Req'd	Part	Time Allowed Hours*	Material Cost
	Cut off stock	.75	.....
1	No. 1	10.0	$4.00
1	No. 2	1.25	.03
3	No. 3	4.0	.20
3	No. 4	.75	.03
6	No. 5	.....	.60
6	No. 6	.....	.24
	No. 7	1.5	.03
3	No. 8	.....	.15
	Hardening	.75	.....
	Assemble	1.0	.....
	Inspect	1.0	.....
		21.00 hrs.	$5.28

*Pattern—7 hr.

Table IV—Templet

Req'd	Part	Time Allowed Hours*	Material Cost
	Cut off material	.80	.....
1	No. 1 (Grind. Dept. 3; Mill " 3; Boring " 10)	16.0	$3.60
1	No. 2	8.0	.50
2	No. 3	4.0	.25
1	No. 4 Tap hole	.5	.65
1	No. 5	6.0	.35
1	No. 6	.25	.02
4	No. 7 Tap holes	2.0	2.60
5	No. 8 " "	2.5	3.75
	Hardening	1.5	.....
	Assembling	5.0	.....
	Inspect	2.5	.....
		49.05 hrs.	$11.72

*Pattern—6 hrs.

DET. NO.	NO. REQ.	MATERIAL	FINISH STOCK SIZE	TREATMENT
1	3	Std.	3/8-16 x 1 1/2 Headless Set Scr.	
2	3	C.R.S.	3/8 diam. x 2 3/16	
3	6	Std.	3/8-16 hex. nut	
4	6	Std.	3/8 washers	
5	3	M.W.	Spring to suit	
6	3	C.R.S.	2 7/8 x 1 1/4 x 1/2	Cyan.
7	1	D.R.	9/16 diam. x 2 3/4	Hdn.
8	1	C.I.	Pattern	

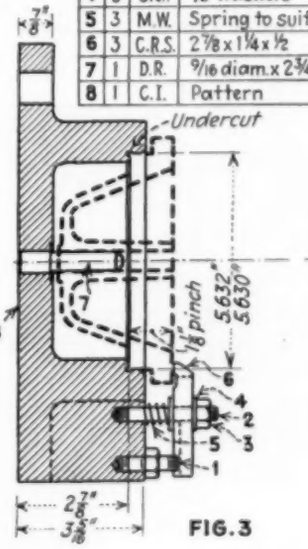
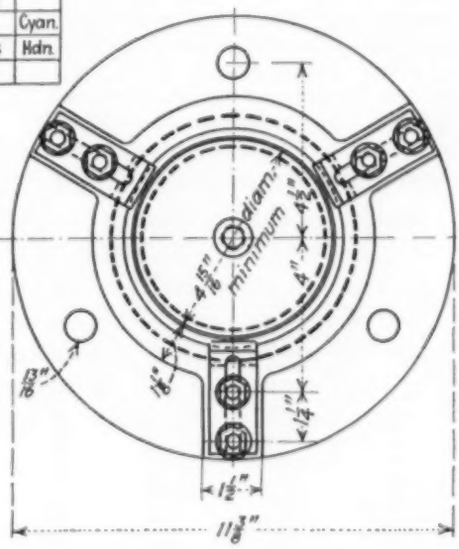


FIG. 3



is seen in Fig. 4. The piece to be drilled, shown at *AA*, gives an idea of the work done. The templet rests on the machined surface *B* and the plugs *2* and *5* locate it in the holes *C* and *D* respectively. The holes drilled are shown by *X's*. The two special bushings guide the drills to depressed surfaces.

The piece to be drilled contains three sets of holes so that the templet is simply moved over to the next pair of holes after the first twelve holes are drilled as marked in Fig. 4. Details of the templet are shown in Fig. 5. The drill bushings are also marked X in this figure.

The pattern work for this templet is given as six hours, while the time al-

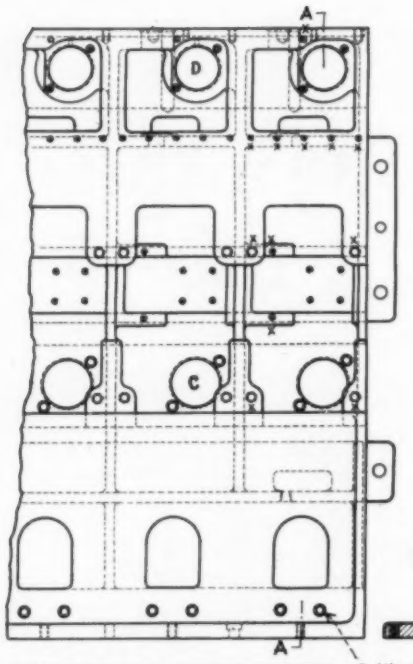
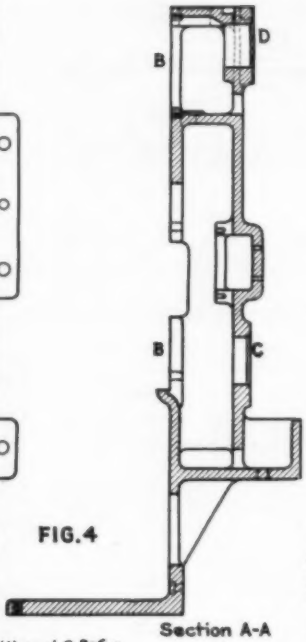


FIG. 4



DET. NO.	NO. REQ.	MAT.	FINISH STOCK SIZE	TREAT
1	1	C.I.	Patt. 3308-1860	
2	1	M.S.	2⅛" dia. x 5⅞" lg.	Pk. Hd.
3	2	T.S.	¾" dia. x 3" lg.	Hard
4	1	STK	'Briney' Bush No. -72 C	
5	1	M.S.	1⅛" x 2¼ x 4¾" lg.	Pk. Hd.
6	1	C.R.S.	¼" dia. x ⅞" lg.	
7	4	STK	'Briney' Bush No. 73 B	
8	5	STK	'Briney' Bush No. 71 C	

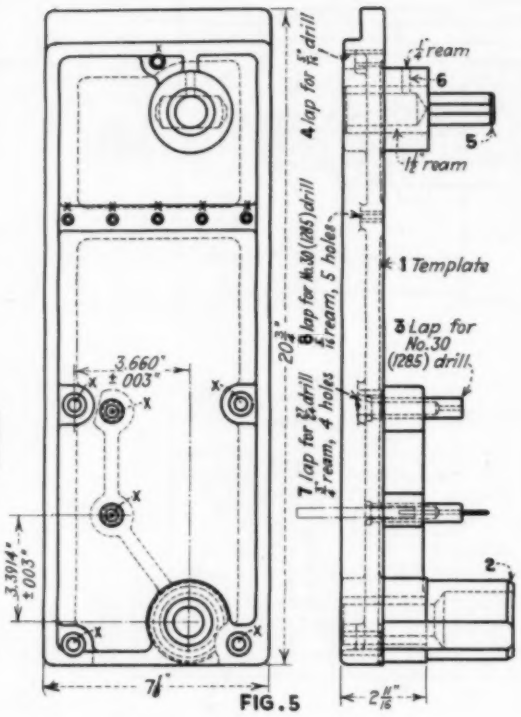


FIG. 5

lowed and the material costs are shown in Table IV.

A pilot boring fixture is shown in Fig. 6. The work is centered from its outside surfaces, being held firmly in position by clamp *13* and screw *21*. Clamps *8* and *17* hold the work rigidly down against the fixture seat. Clamp *13* has a free rocking bearing at its inner end and is operated by the threaded knob *15*, which works on the stud *14*, the spring *16* opening the clamp when pressure is released. The pilot bushing *12* is of mild steel, pack hardened, and a push fit in the center of the casting.

The 22 details of this fixture are shown in the materials list in Fig. 6 and the time allowance and cost of each is given in Table V.

In figuring the final price for a job the total hours given in the table are multiplied by the current labor rate. This current labor rate, as used by Taft-Peirce, is a single figure, but it includes not only the cost of direct labor but burden and overhead as well. Since these factors are all variables the multiplier must be changed from time to time to accord with conditions. The cost of materials is added to the figure obtained by multiplying the total time allowance by the hourly rate to arrive at the final cost.

DET. No.	No. REQ.	MAT.	FINISH STOCK SIZE	TREAT.
1	1	C.I.	Patt. No. 3308-1-4-126	—
2	8	Stock	Hex. cap scr. ½-13 x 1½	—
3	1	C.R.S.	1 x 1¾ x 6½	Cyan.
4	4	Stock	Plain washer ¾	—
5	4	Stock	Hex. nut ¾-10	—
6	2	Stock	Hdless. set scr. ⅜-10 x 2½	—
7	1	C.R.S.	¾ diam. x 8⅛	—
8	1	C.R.S.	¾ x 2 x 7	—
9	1	D.R.	¾ diam. x 1⅜	Hdn.
10	2	Spring wire - to suit		Temper
11	2	C.R.S.	1½ diam. x 4⅜	—
12	1	M.S.	1½ diam. x 4	Pt. hdn.
13	1	C.R.S.	¾ x 4 x 9½	Cyan.
14	1	C.R.S.	¾ diam. x 4	Cyan. and hdn.
15	1	Stock	Hand knob ¾-10 tap	—
16	1	Spring wire - to suit		Temper
17	1	C.R.S.	1 x 1¾ x 6½	Cyan.
18	1	C.R.S.	¾ x 2 x 7	—
19	1	C.R.S.	¾ diam. x 8½	—
20	1	Stock	Hand knob ⅜ ream	—
21	1	C.R.S.	⅝ diam. x 4½	Cyan. and hdn.
22	1	D.R.	⅜ diam. x 1½	—

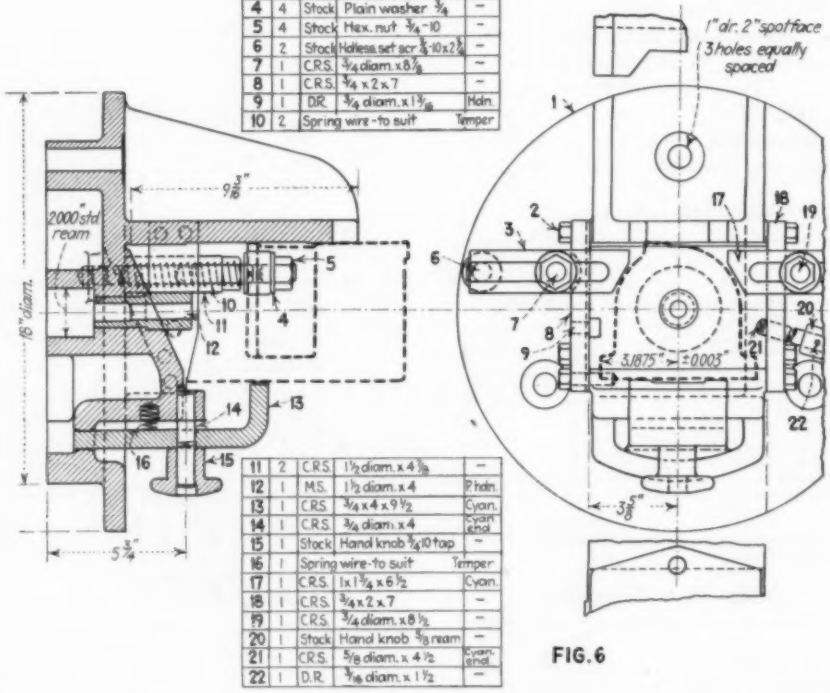


FIG. 6

Table V—Boring Fixture

Req'd	Part	Time Allowed Hours*	Material Cost
	Cut off material	1.75	.....
1	No. 1 { Planing Dept. / Scraping Dept. / Tool Room }	20.00 / 3.50 / 20.00	$11.20
8	No. 2	.....	.40
1	No. 3	2.00	.35
4	No. 4	.....	.40
4	No. 5	.....	.40
2	No. 6	.....	.20
1	No. 7	1.00	.10
1	No. 8	1.50	.30
1	No. 9	1.50	.05
2	No. 10	1.00	.03
2	No. 11	3.00	.30
1	No. 12	4.00	.63
1	No. 13 { Forge Shop. / Tool Room }	1.00 / 2.50	.85
1	No. 14	1.50	.05
1	No. 15	1.50	.15
1	No. 16	.50	.03
1	No. 17	2.00	.35
1	No. 18	2.50	.30
1	No. 19	1.00	.10
1	No. 20	1.50	.15
1	No. 21	1.50	.06
1	No. 22	1.50	.05
	Hardening	2.00	.....
	Assembling	2.00	.....
	Inspect	3.00	.....
		83.25 hrs.	$16.45

*Pattern—15 hrs.

EDITORIALS

VOLUME 78 AMERICAN MACHINIST ESTABLISHED 1877 McGRAW-HILL PUBLISHING COMPANY, INC. NUMBER 21

K. H. CONDIT F. H. COLVIN
EDITORS

MR. ROOSEVELT TAKES INVENTORY

INSTEAD OF WAITING for the turn of the year, the usual time for inventory and re-ordering, the Administration is hard at the task now. And what a task!

Has model NRA gone well with the customers? If not, should it be cut off the stock list, or redesigned to make it more satisfactory?

And what about models AAA and CCC and FERA? Or FHA and TVA and RFC?

As a matter of fact the models in the C series, CCC and RFC, seem to have been more successful than those in the A series. But it will not do to generalize. Each one must be considered on its record and on its merits. Some ought to be scrapped as obsolete, or as mistakes from their introduction. Possibly somebody's enthusiasm got the better of his judgment in developing them. He thought he saw a need and a market where there really was none.

Let's not be too critical of some of the failures of the young engineers the President called in to design the models in his line of New Deal products. For the most part they worked hard and honestly.

But now that the trial period of these models in the hands of the public has shown certain weaknesses and a few failures, the President is quite right in taking inventory of them all as a first step in deciding what to do with them.

IN ARRIVING at such a decision a private enterprise often finds it wise to call in consultants, either engineers or market specialists, or both. Mr. Roosevelt is following an analogous course in his interviews with industrial leaders. It is our conviction that he will not find them lacking in willingness to assist or in ability to correct errors.

In their own interest and for the good of their country we urge them to accept every invitation to advise and help. We trust that the President will listen to the advice of practical experience.

Looking Forward

President Roosevelt in his radio address on September 30, said:

"Is it not a fact that ever since the year 1909 Great Britain in many ways has advanced further along lines of social security than the United States? Is it not a fact that relations between capital and labor on the basis of collective bargaining are much further advanced in Great Britain than in the United States?

"It is perhaps not strange that the conservative British press has told us with pardonable irony that much of our New Deal program is only an attempt to catch up with English reforms that go back ten years or more."

A cable from England to the New York Times on October 4, said:

"In the hope of such an electoral victory, the annual Labor party conference at Southport this week has determined upon the socialization of industries, land, transportation and banking by taking these enterprises away from private interests and placing them under State ownership and control.

"All of these things have been considered by the party for years, but always as something reserved for the remote future in the development of British socialism. Now the policy has become definite and immediate."

Don't Chisel Wages

OF ALL the bad, chiseling, penny-pinching policies to which a manager can stoop under the stress of competition, the worst is to pay a skilled workman less than he is worth. In the first place, it is unfair to the man. Skilled mechanics in the metal-working industry get little enough as it is compared with what the skilled men in some other trades get. In the second place it is unfair to the company, which will get a bad reputation and will have serious difficulty in recruiting a force when times are good and men are scarce. In the third place it is unfair to the industry because labor peace under present conditions is hardly better than an armed truce which may be broken by such an injustice with results that no man can foresee.

.CHIPS.

Washington—Johnson's resignation as administrator of NRA is submitted to the President and accepted with all the proper sentiments . . . New set-up includes Ickes, Perkins, Hopkins and Davis on the policy board with Richberg as chairman; Williams, Whiteside, Hillman, Marshall and Hamilton on the administrative board; judicial board yet to be appointed . . . President and Hopkins warn states and cities that relief buck cannot be passed to Washington . . . A. L. Deane offers plan for unemployment insurance and relief independent of Federal aid except for administrative expense . . . Roosevelt in broadcast urges truce between employers and labor, expresses belief in necessity of profits . . . A. F. of L. demands revision of NIRA with better break for labor . . . Secretary Dern establishes headquarters air force of 1,000 planes, in five wings, under Col. Danforth . . . Secretaries Swanson and Roper agree on plan to have naval officers assigned to merchant ships as inspectors.

Foreign—Queen Mary of England launches giant Cunarder which is named after her . . . Geneva worried over how to care for new flood of German refugees expected if Saar vote favors Nazis . . . Mussolini denies jobs to unmarried men and women in effort to stimulate birth rate . . . Russian debt negotiations off again, Bullitt takes vacation, plans for American embassy building held up . . . France to underwrite portion of internal Italian loan as part of political, military and economic agreement that is likely to have important effect on European affairs . . . Soviets restore votes to Kulaks who have "reformed" . . . German export control paralyzes trade . . . British Labor Party to socialize industry if it wins election . . . Fatal riots in Spain.

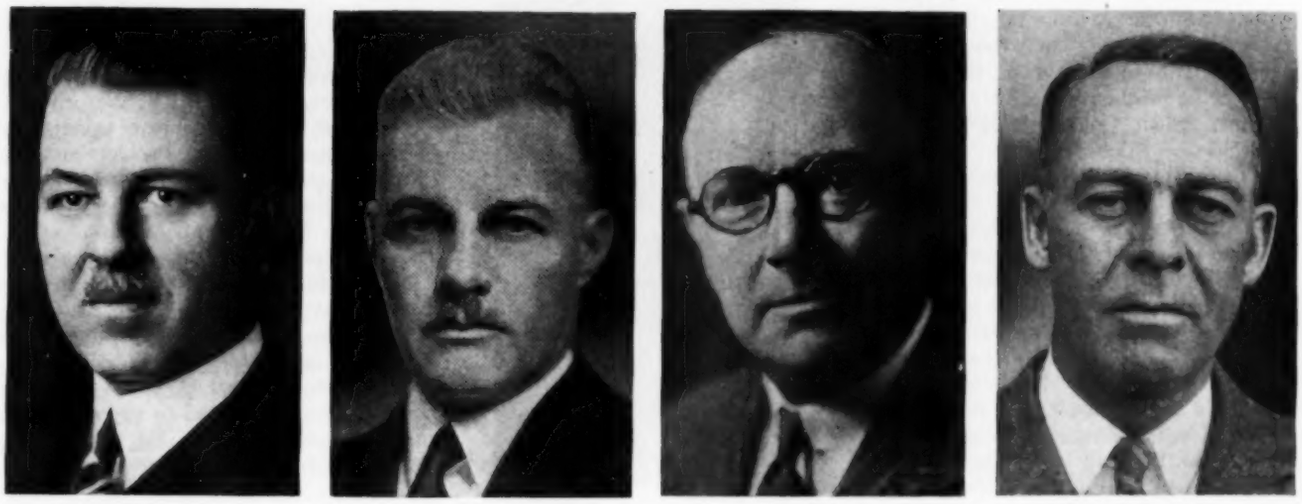
Finance—Treasury announces conversion of 80 per cent of outstanding Fourth Liberties . . . Director of the U. S. Mint reports coining money as fast as possible "to meet demands of Industry" . . . Advisory Council of Federal Reserve Board issues report demanding return to gold standard and steps to balance budget, condemning lack of consistent monetary policy and government competition with private business . . . Board chairman says Council exceeded its powers . . . China's protest at harm done her by U. S. silver policy leads to conference of Roosevelt, Hull and Morgenthau . . . New Commission margin rules accepted by Wall Street brokers without much comment . . . Rules more lenient than had been expected . . . Federal Reserve Board reports granting 178 industrial loans totaling $8,500,000 . . . First quarter Treasury deficit is over $500,000,000 . . . Possibility of election of Upton Sinclair drives capital from California.

Industry—Battle lines drawn for finish fight between advocates of horizontal and vertical unions at A. F. of L. convention . . . Roosevelt appoints steel board, Stacy, Wiley and Mullenback, to act in similar capacity for textile industry . . . Chicago bus union leader charged with hiring thugs who killed inspector . . . Vice president Arthur Young, author of Steel Corporation employee representation plan, defends it before Steel Labor Board . . . Treasurer's report shows A. F. of L. has 2,600,000 paid members . . . Convention demands ban on "company unions."

Trade—Cuba reports improvement in business and sentiment following trade treaty . . . August exports at $172,000,000 best for any August since 1930.

Indicators—Steel production up—Carloadings down—Electrical power output up—Business Week's Index down slightly.

President | *First Vice-President* | *Second Vice-President* | *Treasurer*



C. J. STILWELL | N. D. MACLEOD | C. R. BURT | H. H. PEASE

New Officers of the National Machine Tool Builders' Association

Jordan Urges Industry to Cooperate With the Administration

Indicative of the change that has come over the political and economic situation in the last few weeks is the advice of Dr. Virgil Jordan, president of the National Conference Board, that business men cooperate with the Administration in its efforts to promote recovery. This advice was given in the course of an address before the National Machine Tool Builders' Association at its meeting in Atlantic City, Oct. 1-4. Dr. Jordan believes that national affairs are at a turning point, and that effective cooperation now may help to swing the decision to a more conservative attitude. The final outcome will rest largely with American public opinion. That opinion, when expressed on real issues, will be found to be basically conservative.

Dr. Jordan reviewed the course of the nation during the first eighteen months of the New Deal. The pattern for the administration of the government during this period, he declared, has been "tammunism"—in which the method of government follows the precepts of Tammany and the economic doctrines are borrowed from Communism. Dr. Jordan explained in detail how these policies have led to the reduction of the profits in private enterprise, to an increasing competition by the government with private business, to the encouragement of unionization, to the shutting off of the flow of private capital into investments etc. He stated that in 1933, 40 per cent of the national income including the flow of loans, passed through the hands of government agencies. This percentage, he declared, is higher than that in any other country except Russia, and possibly Italy.

The decision as to whether the nation will continue on this road of state capitalism or will change its course now hangs in the balance. "The chances seem slightly better today than at any time in eighteen months," said Dr. Jordan, "that we will turn off that road and try another." In explaining this opinion, he cited the present financial problem of the government. He pointed out that the success of federal financing plans will depend more upon the revival of private business than heretofore. One quarter of the deficit is represented by loans. As long as these loans remain good, that part of the deficit is not real. But, if repayment of them is impaired, then the deficit becomes real. This situation hangs as a shadow over the Administration and is a potential influence for conservative action.

A second similar factor is the labor problem. Enormous forces were unloosed by the Administration's policies on labor relations. The necessity of holding these in check will exert a constant pressure for leaning to the right.

If we continue on the present road, instead of turning at the crossroads, two inevitable further steps will take us all the way to state capitalism. These two steps are the compulsory employment of all the unemployed, regardless of ability or efficiency, and nationalization of credit; and if taken they will seal the fate of private industry and initiative. On the other hand, if industry offers a constructive solution of the unemployment problem and plays its part in this expansion of credit by vigorous resumption of enterprise, this fatal outcome may well be avoided.

At the meeting of the whole industry on the first day of the convention, Henry Buker, vice-president, Brown & Sharpe Mfg. Co., and chairman of the Supervisory Agency, stated that the code has been administered as written. The Agency protested the executive order authorizing the 15 per cent price cut to government buyers as inconsistent with what has proved to be sound practice in the machine tool industry for many years. Herman H. Lind, executive officer of the Agency and general manager of the Association, attributed the small number of complaints that have arisen to the simplicity of the code, which expressed only the established practice of the industry.

Robert M. Gaylord, president, Ingersoll Milling Machine Co., and representative of the Association to the Machinery and Allied Products Institute and the Durable Goods Industries Committee, explained that the latter body is organized to function only during the emergency and to disband immediately thereafter. MAPI, on the other hand, is a continuing body, comparable to the National Electrical Manufacturers' Association and the National Automobile Chamber of Commerce. Its staff has done valuable work in watch-

ing all codes that contain clauses restricting the use of machinery, or provisions that overlap those in other codes. It is also collecting facts on old age pensions and unemployment insurance so that the machinery industry shall be informed when Congressional hearings on legislation begin.

A. E. Drissner, vice-president of engineering, National Acme Co., recounted his experiences on an extended visit to machine tool plants in England and Europe. He called particular attention to the marked advances in design and manufacturing technique of the British machine tool builders, and to the activity of these companies. Supporting Mr. Drissner's statements, Chas. J. Stilwell, vice-president, Warner & Swasey Co., stated that England is far ahead of us in the use of tungsten carbide cutters, and in the design of machines for them.

In his presidential address, Edward A. Muller, president, King Machine Tool Co., called attention to the manner in which the Association had endeavored to cooperate with NRA and the Administration. He urged the members not to protest awards of Federal orders because of the irritation such complaints occasion.

Herman H. Lind, in his report as general manager, had this to say: "There is one result of the higher wages and shorter hours that is beginning to show its effect on our industry in a substantial way. Higher wages and shorter hours make necessary cost saving equipment wherever it can be used. That this is taking hold is well illustrated by sales in our own industry this summer. It is particularly pointed for sales in the month of August. Whereas during the month *Business Week's* general index went down 7 per cent, our own increase over July sales was 20 per cent. An analysis discloses that 53 per cent of the companies in our industry increased their business so that it is plain this increase was not the result of a chance order or two.

"It would seem to be the part of wisdom for business men to make their plans with the expectation that the present labor provisions or something akin will prevail, also that there will be a certain amount of fair trade practice provisions with increasing attempts at enforcement. It is almost certain that price fixing will not be tolerated, but possibly there will be a better understanding of the nature of open price plans and that these may be sanctioned. There is very certain to be a demand for more statistical information to show the condition of the various industries. Our industry costs may be expected to increase, and this might take place very rapidly with any substantial increase in business.

Dealer President

W. F. McCarthy

Treasurer

Harry Barney

"It is difficult at this time to make specific predictions as to the details of these general provisions but there is every evidence that the new NRA Committee will attempt to arrive at conclusions in an intelligent way. Ultimately Congress will be the deciding factor of many of these things and therefore it is essential that business be in position to present its problems and its needs, and that it do so constantly.

Three new directors were elected to the board: Clayton R. Burt, president, Pratt & Whitney Co.; Eugene C. Clark, president, Chambersburg Engineering Co.; and Henry C. Pierle, secretary, R. K. LeBlond Machine Tool Co. The new board organized by electing Charles J. Stilwell president; Norman D. MacLeod, president of the Abrasive Machine Tool Co., first vice-president; Clayton R. Burt second vice-president, and H. H. Pease, president of the New Britain-Gridley Co., treasurer.

W. F. McCarthy Heads Machine Tool Dealers

Marked by the largest attendance since the establishment of the organization, and by the presence of several representatives from the Pacific coast, the annual meeting of the Associated Machine Tool Dealers was held at the Olympia Fields Country Club, near Chicago, September 26-28. An open meeting of the trade took place on the first day. At this meeting there was some discussion of terms of sale, means for raising funds for code administration and trade-in plans. A nominating committee was appointed to propose names for membership on the Supervisory Agency to be voted on December 1. Kenneth H. Condit, editor, *American Machinist*, addressed the meeting on the future of the machine tool industry and the place of the dealer in it.

At the meeting of the association a new draft of constitution and by-laws more in line with current requirements under NRA code operation was offered by Stanley Motch, chairman of the by-laws committee. After some discussion a resolution was adopted calling on the members of the Supervisory Agency to bring up for consideration the placing of all machine tool sales under one NRA code. A report from a special committee which had been considering the advisability of recommending a larger discount for West Coast dealers brought in a report asking for an additional five per cent. The principal reasons offered in support of this recommendation were the higher sales expense of the West Coast dealer in his sparsely settled territory, and the lessened cost of service and contact on the part of the manufacturer, service being handled in this territory by the dealers. It was also suggested that the Association's name be changed to "National Machine Tool Distributors Association."

The following new officers and directors were elected: President, W. F. McCarthy, Henry Prentiss & Co., New York; Vice-president, N. A. Booz, Federal Machinery Sales Co., Chicago; Secretary, J. R. VanDyck, VanDyck Churchill Co., New York; Treasurer, Harry Barney, Barney Machinery Co., Pittsburgh; Directors, R. G. English, English & Miller Machinery Co., Detroit; C. C. Brogan, W. E. Shipley Machinery Co., Philadelphia; O. S. Hunt, Marshall & Huschart Machinery Co. of Indiana. Ex-president George N. Cherrington continues as chairman of the Supervisory Agency until the December election. He was given a rising vote of thanks for his tireless work as head of both the Supervisory Agency and the association during the past year.

Metal Men Have Successful Week

With greatly increased attendance and a lively interest in the exhibits and technical sessions, visitors to the National Metal Congress left October 5 after a highly successful week. The American Society for Metals, the American Welding Society, the Wire Association, the American Institute of Mining and Metallurgical Engineers and the American Society of Mechanical Engineers all cooperated in presenting a variety of programs to suit every taste.

High spots of the program were the grain size symposium held on the concluding day by the A.S.M. and the symposium on qualifying operators held by the A.W.S. On grain size, papers were presented by M. A. Grossman, Illinois Steel Co., E. S. Davenport and E. S. Bain, U. S. Steel Corporation, H. W. Graham, Jones & Laughlin Steel Corporation, S. Epstein, Battelle Memorial Institute, J. H. Nead and T. S. Washburn, Inland Steel Co., B. F. Shepherd, Ingersoll Rand Co., H. W. McQuaid, Republic Steel Corporation, Philip Schane, Jr., Carnegie Steel Co., W. E. Sanders, Delco Products Division, General Motors Corporation, A. E. White and C. L. Clark, University of Michigan, R. L. Kenyon, American Rolling Mill Co., W. E. Rudder, General Electric Co., and Howard Scott, Westinghouse Electric & Mfg. Co.

Taking part in the welder training session were W. D. Halsey, Hartford Steam Boiler Inspection & Insurance Co., Alexander Kidd, M. W. Kellogg Co., E. D. Debes, Bethlehem Shipbuilding Co., H. W. Pierce, New York Shipbuilding Co., G. D. Fish, Westinghouse Electric & Mfg. Co., Dr. Lewis Land and John H. Zink, Heating, Piping and Air Conditioning Contractors National Association and J. W. Owens, National Weld Testing Bureau.

The following new officers, nominated last spring, assumed their positions at the close of the convention:

President—B. F. Shepherd, manager Rock Drill Division, Ingersoll Rand Co.

Vice-President—R. S. Archer, chief metallurgist, Republic Steel Corp.

Secretary—W. H. Eisenman.

New trustees (elected for two years)—Walter Matheius, assistant general superintendent, Illinois Steel Co.; G. B. Waterhouse, professor of metallurgy, Massachusetts Institute of Technology.

Dr. V. N. Krevobok, professor of metallurgy, Carnegie Institute of Technology, presented the Campbell Memorial Lecture for 1934 on "Alloys of Iron and Chromium."

John Chipman, research engineer, University of Michigan, was awarded the Henry Marion Howe gold medal for the best paper during the past year. "Application of Thermodynamics to the Deoxidation of Liquid Steel" was the subject of Dr. Chipman's paper.

Lyon Sales Manager

FRED B. HEITKAMP

F. B. Heitkamp Made Lyon Sales Manager

Frederick B. Heitkamp, formerly general sales manager of the Cincinnati Milling Machine Co. and Cincinnati Grinders, Inc., has been appointed general sales manager of Lyon Metal Products, according to an announcement by Earle D. Power, vice-president and general manager. Mr. Heitkamp joined the Lyon executive staff last June. His previous activity with the American Management Association, the American Marketing Society and the National Advertising Association has made him a familiar figure in industrial circles. He has been a frequent speaker at meetings of these organizations throughout the country.

In his new position Mr. Heitkamp will supervise all sales activity, including advertising and sales promotion, and will have associated with him a complete selling organization covering four major divisions of company activity. His immediate duties will also include the managing of the steel equipment division, marketing steel lockers, shelving boxes and factory and institutional equipment.

• INDUSTRIAL REVIEW •

• Despite the evident efforts of President Roosevelt and the Administration to encourage private enterprise no appreciable signs of improvement are in sight in the machinery industry. In some parts of the country inquiries continue to be fairly vigorous but orders for anything but repair parts are extremely few. The home modernization campaign has not progressed far enough to produce any effect on the machinery companies that sell to the companies that supply equipment for home modernization, and the direct loans to industry have done nothing to help the machinery business. Foreign sales have been good for builders of certain types of machine tools but the big Russian market remains closed as the diplomats discuss the debts, and get nowhere.

• Business is almost at a standstill in the territory served from Boston, New York and Philadelphia. Later in the year these centers should profit from arsenal orders but the lists for this equipment have not as yet been released. Pittsburgh is equally pessimistic about prospects for the balance of the year. Some few inquiries are afoot but the total amount involved is not large. In Cleveland inquiries are numerous but the same cannot be said for orders. They are as dull as for the Eastern centers.

• Detroit has had no time for anything but baseball for several weeks. A few special machine tools have been ordered for new automobile models and other production batteries have been authorized, but sales of standard tools have been limited. Families on relief are close to the depression peak record. Indianapolis is somewhat more encouraging in that it reports a much better percentage of closing on inquiries even though they are fewer in number. Neither orders nor inquiries have been numerous in Cincinnati. Interest there centers in the 50th Anniversary celebration of the Cincinnati Milling Machine Co.

• In St. Louis inquiries are somewhat better but the fall spurt has failed to materialize. September business in Chicago was much below that of August but October promises to be a little better. Milwaukee is quiet.

Reequipment for New Models Gains Momentum

DETROIT—August factory sales of automobiles, including Canadian, totalled 244,713 units of which 58,634 represented truck sales. This compares with 277,690 and 50,115 units respectively for July, according to figures released by the Department of Commerce. September output is expected to run above 180,000 units. August retail sales ran ahead of the same month last year, with September sales estimated to be about equal to September production. Under the impetus of increased sales efforts some companies are reporting contra-seasonal sales the first twenty days of September. October and November are expected to be largely clean-up months for reduction of dealer stocks.

The larger tool and die shops in Detroit are reported as moderately busy with new work, while in many smaller shops operations have not yet reached a profitable stage. Failure of Detroit shops to be as busy as last year is not to any great extent due to work being sent outside this area. Two things seem to have caused this condition: new model spacing and less radical changes than last year.

Although not given the weight of official sanction it is anticipated that Buick will retain present models well into next summer. Packard, except for the small car, and Auburn are accounted for. While a matter of conjecture, it seems unlikely that a move as radical as the Chrysler Airflow is in prospect for 1935 or that the airflow lines are to be radically changed. Were radical changes in prospect and were the new models to be shown at the New York Show, tool shops should be busy at present since about 90 calendar days only remain. This spacing of models is certain to relieve the pressure on tool shops and to give them an opportunity to plan their work more effectively. However, slowly maturing plans will result in more tool and die work being done in corporation shops. One large manufacturer is reported to have dropped several million dollars in correcting dies made last fall and one model of another was lost in the rush for tools and dies and not brought out at all.

Press equipment, as reported in our last issue, rules as favorite in equipment purchases. Ford is adding building space, presses, and the necessary electrical equipment to make one type of body at the Rouge plant. This expansion is not to be a subtraction from the business awarded to Murray and Briggs, but to prepare for anticipated increase in business next year. Some difficulty was experienced by Ford in getting delivery of bodies during the spring rush due to the 100 per cent expansion in output over last year which taxed body sources severely. The press equipment, reported the largest constructed to date, will stamp bodies in larger sections than heretofore.

Aside from presses and Ford purchases, Packard has purchased equipment for the light car cylinder line. Other companies have not released or authorized new equipment in substantial amounts. Considerations point to the necessity of doing this in the near future. Production in the United States and Canada for first eight months of this year increased 54 per cent over last year, thus furnishing a sound basis for the optimism shown in the Ford, Fisher and Packard programs. The experience with increasing retail car prices last spring and the undoubted increase in operating costs make investments in machines for increased efficiency imperative. Then, too, there has been so little machinery replaced in the past four and one-half years and that on the books written off so quickly that the outlook is promising.

The factors holding up these programs are largely uncertainties as to the mone-

Metal-Working Code Hearings Scheduled

Date	Place	Deputy Administrator	Association
Oct. 10	Commerce Building	D. A. Tutein	National Electrical Manufacturers Association (Electrical tool division)
Oct. 11	Raleigh Hotel	D. A. Tutein	National Electrical Manufacturers Association (Portable Electric Lamp Division)
Oct. 15	Commerce Building	H. F. White	National Metal Spinners (division of F.M.P.F.)
Oct. 15	Commerce Building	N. W. Foster	Print Cutting Jobbers (amendment)

Exports of Machinery During August, 1934

	August, 1934	July, 1934	August, 1933
Electrical machinery	$5,971,444	$5,758,896	$3,561,785
Power generating machinery (except automotive and electric)	591,258	618,903	366,941
Construction and conveying machinery	500,490	527,933	300,119
Mining, well and pumping machinery	2,278,572	2,094,222	1,189,295
Power-driven, metal-working machinery	1,546,157	1,638,865	825,104
Other metal-working machinery	147,806	170,714	116,538
Textile machinery	615,788	505,959	402,940

Exports of Metal-Working Machinery During August, 1934

	August, 1934	July, 1934	August, 1933
Engine lathes	$19,794	$32,374	$24,254
Turret lathes	32,121	18,617	28,035
Other lathes	97,063	56,204	9,246
Vertical boring mills and chucking machines	48,638	23,707	10,920
Thread-cutting and automatic screw machines	117,639	74,592	29,595
Knee and column type milling machines	52,962	2,898	65,615
Other milling machines	73,934	34,010	26,231
Gear-cutting machines	90,382	90,300	78,614
Vertical drilling machines	4,597	7,379	46,192
Radial drilling machines	7,355	1,202	5,553
Other drilling machines	46,641	99,012	20,618
Planers and shapers	12,798	15,244	22,488
Surface grinding machines	34,030	29,267	8,409
External cylindrical grinding machines	76,064	39,639	36,858
Internal grinding machines	60,956	95,972	20,400
Tool grinding, cutter grinding, and universal grinding machines	41,115	55,773	27,090
Other metal-grinding machines	26,414	52,641	22,359
Sheet and plate metal-working machines	237,577	130,848	90,989
Forging machinery	101,562	86,113	28,253
Rolling mill machinery	95,119	91,072	63,658
Foundry and molding equipment	84,515	23,021	23,340
Other power-driven metal-working machinery and parts	184,881	578,980	136,387
Other Metal-Working Machinery			
Pneumatic portable tools	$34,642	$61,191	$47,729
Other portable and hand or foot operated metal-working machines and parts	45,881	44,106	33,076
Chucks for machine tools	8,608	10,360	5,417
Machine-operated pipe and thread cutters, stocks, dies, taps, and other machine-operated cutting tools	40,209	35,634	17,775
Other metal-working machine tools	18,466	19,423	12,541

tary policies of the Administration, the labor situation and the strength of the 30-hour week movement which without question will be strongly pressed by labor at the code renewal in early November.

Continental Motors Corporation announced $290,000 of orders from the Ordnance Department for radial engines for tanks and combat cars. . . . The War Department awarded, September 28, 346 trucks to Fargo Motor Corporation and 400 to the Federal Truck Co. . . . Electric Auto-Lite has the Chrysler lighting and ignition business for 1935. . . . E. S. Goodhold becomes production supervisor at Reo, A. J. Brandt assistant general manager at Hupp, and S. C. Bray, sales promotion manager for Pontiac.

Blue Eagle's Demise Seems Near

WASHINGTON—With the newly appointed administrative board considering an abandonment of the boycott method of code enforcement, the days of the Blue Eagle as a bird of prey seem numbered. This will mean a reversion to the law as originally written with the penalties provided by Congress.

The public mind associates the Blue Eagle and the President's Reemployment Agreement as integral parts of NRA. As a matter of fact they were administrative by-ways never contemplated in the Recovery Act. Perhaps this trend will lead eventually to a still closer adherence to the law which makes codification voluntary rather than mandatory upon industry.

The National Industrial Recovery Board which, judging from its initial actions, may swing NRA into the starboard channel, is one of the three arms of the threefold NRA set-up so long heralded. Its members, S. Clay Williams, former president, Reynolds Tobacco Co., Arthur D. Whiteside, president of Dun & Bradstreet, Inc., Sidney Hillman, president, Amalgamated Clothing Workers, Leon C. Marshall, labor specialist and former college professor, and Walton H. Hamilton, professor of constitutional law, Yale University, are charged with the day-to-day functioning of NRA's machinery.

The second arm, or Industrial Emergency Committee, consists of Harold L. Ickes, Secretary of the Interior, Frances Perkins, Secretary of Labor, Harry L. Hopkins, Federal Relief Administrator, Chester C. Davis, Agricultural Adjustment Administrator, Donald R. Richberg, general counsel of NRA, and Mr. Williams whose chairmanship of the administrative board entitles him to sit with the Committee also. This group is to consider industrial policy and its coordination with other New Deal activities. Its findings may serve as a basis for permanent legislation affecting industry.

Both bodies are responsible to the President who has the last word in all cases. A third arm to handle the judicial side of NRA has yet to be appointed.

W. B. Stout Slated for S.A.E. Presidency

William B. Stout, protagonist of the all-metal airplane and designer of a light weight rail car, heads the list of nominations for the Society of Automotive Engineers for 1933. At the same time nine vice-presidents were named for the ballot each to represent a division of professional ability. These are:

Aircraft engineering—C. H. Chatfield, assistant director of research, United Aircraft and Transport Corporation.

Aircraft engines—Philip B. Taylor, chief engineer Wright Aeronautical Corporation.

Diesel engines—C. L. Cummins, president, Cummins Engine Co.

Fuels and lubricants—D. P. Barnard, assistant director of research, Standard Oil Co. (Ind.).

Passenger cars—L. P. Kalb, chief engineer, Continental Motors Corporation.

Passenger car bodies—C. O. Richards, body engineer, Cadillac Motor Car Co.

Production engineering—V. P. Rumely, Hudson Motor Car Co.

Transportation and maintenance—T. C. Smith, engineer motor vehicles and construction apparatus, American Telephone & Telegraph Co.

Trucks, buses and rail cars—C. O. Guernsey, chief engineer, J. G. Brill Co.

David Beecroft, manager of the New York office, Bendix Aviation Corporation, was nominated as treasurer for the third time.

All officers are ex-officio members of the council, the governing body. In addition three members at large have been nominated to serve for the 1935-1936 term. They are F. C. Horner, assistant to the vice-president, General Motors Corporation; Harry T. Woolson, chief engineer, Chrysler Corporation; and Austin M. Wolf, consulting engineer.

Gear Makers To Meet at Milwaukee

Milwaukee will be the scene of the semi-annual convention of the American Gear Manufacturers Association to be held on October 22-23. Among the papers and addresses to be heard are:

S.A.E. Nominee

W. B. STOUT

"Modern Methods of Transmission"—P. C. Day, Falk Corporation.

"Advantages of Sykes Herringbone Gears"—W. E. Sykes, Farrel-Birmingham.

"Fallacy of Price Cutting as a Basis of Getting Sales"—Paul Christensen, Cincinnati Gear Works.

"Status of Our Code"—H. H. Kerr, Boston Gear Works.

"Good Steel Foundry Practice"—Arthur Simonson, Falk Corporation.

"Welded Steel Construction"—Thomas Holloway, United Engineering and Foundry Co.

"British Standards"—F. E. McMullen, Gleason Works and Prof. Frank Mickle, University of Michigan.

The meeting will include a visit to the Falk plant on Tuesday afternoon, October 23.

• BUSINESS ITEMS •

Gears & Forgings, Inc., which has general offices at Cleveland, Ohio, and which has been in receivership since April 1, 1932, has affected a reorganization under the name of Ohio Forge & Machine Corp. This company will operate the former Ohio Forge and Van Dorn Dutton Divisions of Gears & Forgings, Inc., at Cleveland. Officers are: F. H. CHAPIN, president of The National Acme Co., as chairman of the board; S. C. DALBEY and J. M. CLEM, who formerly operated the Ohio Forge Company before the merger, as president and vice-president respectively; H. B. Newell, formerly of the Fawcus Machine Co., of Pittsburgh and later vice-president in charge of operations of Gears & Forgings, Inc., as executive vice-president, and T. E. LEIGHTON of the original Van Dorn & Dutton Company as secretary and treasurer. The company will be equipped to handle all types of gearings, power transmission equipment of all descriptions, a full line of speed reducers, special machinery,

drop forgings and general forgings. Sales offices will be maintained as formerly in all principal cities.

Danly Machine Specialties, Inc., has been appointed sole representative of the A. O. Smith Corp., for "Smith-Welding." The former company has been producing machine products, die sets and machine specialties by the torch cut and welding method, while the Smith Corporation has maintained engineering service and complete heat-treating and machining facilities for any welded structure. Both plants will operate on jobs under 10 tons, but the Smith plant will concentrate on jobs from 10 tons up. Thus a complete service in the mechanical industries for production of all types of welded parts will be rendered through one organization.

At the National Industrial Association's Convention held recently in Cincinnati, the Timken Roller Bearing Company was awarded first prize for the most effectively conceived and executed industrial advertising campaign of the year.

• PERSONALS •

J. C. Lincoln Awarded Welding Society Medal

The American Welding Society has awarded the Samuel Wylie Miller Medal to John Cromwell Lincoln, chairman of the board, The Lincoln Electric Co., Cleveland, in recognition of his contributions to the advancement of the science of electric fusion welding. Mr. Lincoln has devoted most of his life to research and development of the electric arc as an industrial tool. Under his direction the company produced in 1907 the first variable voltage arc welding machine. Two years later the first redesign of a cast-iron product for arc-welded steel construction was made.

GEORGE T. CHRISTOPHER has been appointed assistant vice-president in charge of manufacturing, the Packard Motor Car Co., Detroit. He will have charge of the production of the new light car. For 17 years Mr. Christopher was associated with the General Motors Corp.

WM. J. BALDWIN has been appointed to a fellowship in the Mellon Institute. The appointment was authorized by the Hommel Company which has sponsored investigation of enamel technology. Mr. Baldwin is a ceramic chemist and will devote most of his time to investigations in plants. His services will be available gratis to companies that are confronted with problems relating to frits.

E. D. SPICER

E. D. SPICER has succeeded Burton L. Delack as manager of the General Electric Company's Schenectady Works. Because of impaired health, Mr. Delack will devote his time to personnel problems. Mr. Spicer joined the company in 1924. In August, 1929, he became assistant works manager.

RICHARD H. GRANT, vice-president of the General Motors Corp., will be the speaker at a production-engineering dinner on October 11, under the joint sponsorship of the Production Activity of the Society of Automotive Engineers and the Detroit Section of the Society.

WILBER H. WINTERS, has been elected vice-president in charge of operations of the American Brake Shoe & Foundry Co., New York. Formerly Mr. Winters was general superintendent of foundries.

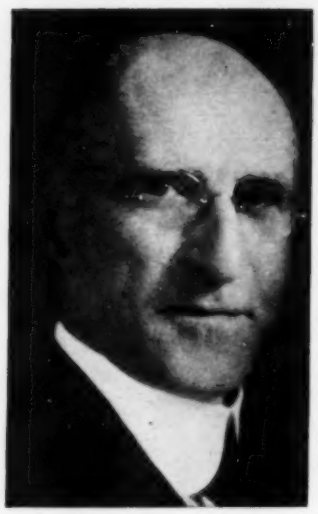
MAX RACHWALSKY of the E. H. Jones Machinery Co., London, Eng., returned to England on the Aquitania on October 3. It is understood that he secured the representation of several prominent American machine tool manufacturers.

• OBITUARIES •

Calvin Rice Dies

Dr. Calvin W. Rice, since 1906 secretary of the American Society of Mechanical Engineers, died suddenly on October 3 at the age of 65. His untiring efforts were responsible not only for the growth and success of the A.S.M.E., but also in the promotion of solidarity in the engineering profession here and abroad.

After his graduation from the Massachusetts Institute of Technology in 1890, Dr. Rice spent a number of years with various industrial concerns mostly in the electrical field. Among these were the



CALVIN W. RICE

Thomson-Houston Electric Co., the General Electric Co., the Anaconda Copper Mining Co., the Silver Lake Mines Co., the Kings County Electric Light & Power Co., Consolidated Telegraph & Electric Subway Co., the New York Edison Co. and the Nernst Lamp Co.

• MEETINGS •

AMERICAN FOUNDRYMEN'S ASSOCIATION. International foundry congress and annual meeting and exposition, Oct. 22-26. Convention Hall, Philadelphia. R. E. KENNEDY, technical secretary, 222 W. Adams St., Chicago, Ill.

AMERICAN GEAR MANUFACTURERS ASSOCIATION. Semi-annual meeting, Oct. 22-23. The New Pfister, Milwaukee, Wis. J. C. MCQUISTON, manager-secretary, Penn-Lincoln Hotel, Wilkinsburg, Pa.

INDUSTRIAL MATERIALS EXHIBIT. Second annual exhibition, Oct. 15-19. Park Central Hotel, New York, N. Y.

INTERNATIONAL ACETYLENE ASSOCIATION. Annual meeting, Nov. 14-16. William Penn Hotel, Pittsburgh, Pa. H. F. REINHARD, secretary, 30 East 42nd St., New York, N. Y.

PACKAGING MACHINERY MANUFACTURERS INSTITUTE. Annual convention, Oct. 12. Edgewater Beach Hotel, Chicago. H. L. STRATTON, secretary, 342 Madison Ave., New York, N. Y.

REFRIGERATING MACHINERY ASSOCIATION. Annual meeting, Oct. 22. Stevens Hotel, Chicago, Ill. Address of association, 915 Southern Bldg., Washington, D. C.

SOCIETY OF AUTOMOTIVE ENGINEERS. National production meeting, Oct. 10-11. Book-Cadillac Hotel, Detroit. JOHN A. C. WARNER, manager, 29 West 39th St., New York, N. Y.

American Machinist
REFERENCE BOOK SHEET ©

Steels for Die-Casting Dies

Practical requirements of a steel for die-casting dies, for casting aluminum for example, are:

1. Machinability
2. Stability in heat-treatment
3. Resistance to heat checking
4. Resistance to deformation, battering, etc.; i.e., hardness
5. Resistance to cleavage cracking on sudden heating or cooling; i.e., toughness
6. Resistance to erosive and solvent action of molten aluminum
7. Cleanliness and uniformity
8. Cost—producibility, forgeability
9. Properties at elevated temperatures

Machinability. From the standpoint of machinability chrome-vanadium steel seems quite satisfactory. Hot-working tungsten steels are more difficult to machine and are considered just barely passable in the die-casting industry. Austenitic steels, in general, are out of the question.

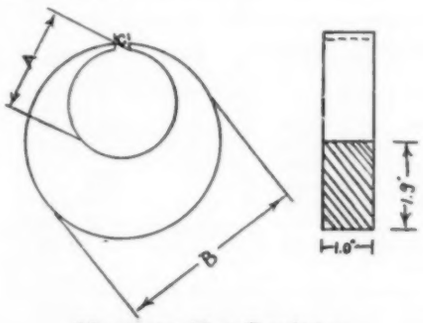
Stability in Heat-Treatment. The standard chrome-vanadium steel used for many years for dies is not satisfactory because of its tendency to warp, grow, shrink and crack during heat-treating process. The tungsten-chromium type of air-hardening die steels is quite satisfactory, but the tungsten-chromium type of oil-hardening die steels is somewhat dangerous inasmuch as it is common practice to have die-casting blocks cut up with very heavy sections next to very thin sections, and with sharp corners between the two. A steel that requires oil quenching is likely to crack at these weak points. An air-hardening type of steel, whether it contains tungsten or not, is preferable for general purposes.

Resistance to Heat Checking. Failure by heat checking seems, to some extent, to be a function of the hardness. In practically all steels tested or used, die life seems to be determined, so far as heat checking is concerned, by the initial hardness.

Hardness. Apart from the relation of hardness to resistance to heat checking, a certain amount of hardness is required for service reasons. All blocks should be hard enough to resist defacement or deformation due to the powerful closing action of the machines when stray pieces of metal are accidentally caught somewhere on the parting faces of the die. From the standpoint of resistance to heat checking, the minimum hardness is considerably above 325 Brinell.

Cleavage Cracking. This difficulty is not encountered in the chrome-vanadium steels except when they are left

Abstracted from a paper presented by Sam Tour, vice-president, Lucius Pitkin, Inc., before the Fall Meeting, Institute of Metals Division and Iron and Steel Division, the American Institute of Mining and Metallurgical Engineers, Inc., New York, Oct. 3, 1934.



Movement Test Specimen

Table I—Results of Tensile Tests

Steel	Original Area, Sq. In.	Yield Point, Lb.	Maximum Load, Lb.	Yield Point, Lb. per Sq. In.	Tensile Strength, Lb. per Sq. In.	Elongation		Reduction of Area, Per Cent	Brinell Hardness	Fracture
						In.	Per Cent			
527	0.2003	52,700	55,720	263,100	278,200	0.16	8.0	19.2	512	Fine granular with silky lip.
528	0.2003	51,800	55,280	258,600	276,000	0.24	12.0	41.9	532	Silky ⅓ cup.
531	0.2003	47,860	49,480	238,930	247,000	0.28	14.0	44.9	477	Silky ⅓ cup.
532	0.2003	52,500	56,030	262,100	279,700	0.07	3.5	5.1	532	Fine granular with silky lip.
533	0.2003	49,100	51,640	245,100	257,800	0.20	10.0	30.9	512	Fine granular with silky lip.

Table II—Results of Movement Tests

Heat-treated Condition		Normalized	Hardened	Drawn	Variation
No. 527	A	2.8992	2.9000+	2.9030+	+0.0038
	B	4.9957	4.9975+	4.9995+	+0.0038
	C	0.5020	0.5195+	0.5200+	+0.0180
No. 528	A	2.9031	2.9022−	2.9042+	+0.0011
	B	4.9930	4.9905−	4.9933+	+0.0003
	C	0.5018	0.5070+	0.5085+	+0.0067
No. 531	A	2.9114	2.9032−	2.9044+	−0.0070
	B	5.0082	5.0023−	5.0032+	−0.0050
	C	0.5180	0.5115−	0.5120+	−0.0060
No. 532	A	2.8995	2.8975−	2.8980+	−0.0015
	B	4.9971	4.9981+	4.9997+	+0.0026
	C	0.5021	0.5014−	0.5012−	−0.0009
No. 533	A	2.9003	2.8984−	2.8980+	−0.0023
	B	5.0025	5.0037+	5.0027−	+0.0002
	C	0.5022	0.5000−	0.5005+	−0.0017

Steels for Die-Casting Dies

at a Brinell hardness of above 477. In the chrome-tungsten steels cleavage cracking is a serious problem and does not seem to have much relation to the Brinell hardness, but appears more closely associated with the macrostructure. In most cases where serious cleavage occurs in chrome-tungsten steel the fracture shows evidence of a fish-scale or a marble structure. As this structure is usually associated with brittleness, it would seem that cleavage cracking is a function of brittleness. The most promising test for this is the notched-bar impact test, and it appears that a steel of a high impact strength at the hardness *at which it is to be used* is least subject to cleavage cracking.

Erosive and Solvent Action of Molten Aluminum. Erosive action becomes severe where the molten metal impinges directly upon a steel surface. Statements have been made that nickel steels are not suitable for dies for aluminum die casting because of this solvent action. That this is not true is indicated by the results obtained on several steels containing up to 5 per cent nickel. The nature of the surface seems to be more important than the composition of the base.

In cooperation with the Vanadium Alloys Steel Co., steels of five different analyses, Table 3, were forged into 4-in. cubes. After forging specimens were annealed by cooling slowly from 1,575 F. Decarburized surfaces were then removed and the blocks heat-treated by cooling in still air from 1,900 F. The No. 527 steel was found to possess a thin scale, which was very adherent and difficult to remove. Steel No. 528 had a heavy, adherent scale, also hard to remove. No. 531 had a thin adherent scale less in amount than that observed on No. 527 and easier to remove. Steel 532 possessed a heavy adherent scale difficult to remove, while steel 533 had a heavy scale which was loosely adherent and easy to remove.

Results of tensile tests are shown in Table 1. The tensile-test specimens were heated to 1,900 F., air-cooled and drawn for 1 hr. at 1,075 F. The movement test specimens were normalized in pitch coke at 1,250 F. before measurements were taken. They were then measured, hardened by packing in pitch coke and heated to 1,900 F. and cooled in still air. After remeasuring they were drawn at 1,075 F. and again measured. The results of these tests are shown in Table 2.

Die-casting dies are subjected to sudden stresses due to local and sudden heating. They operate at temperatures varying from cold up to as high as 800-900 F., or possibly higher. Die steels fail by developing large cracks or fine heat checks. Failures are accentuated by the presence of surface imperfections such as scratches, indicating that the notch effect must be taken into consideration. It would appear, therefore, that a good steel for dies for casting aluminum should have a relatively high impact strength at elevated temperatures, and that there should be no low areas in the impact-strength temperature curve. In Fig. 1 are curves for Charpy tests on steels in Table III.

Fig. 1—Impact Tests for Die-Casting Die Steels at Elevated Temperatures

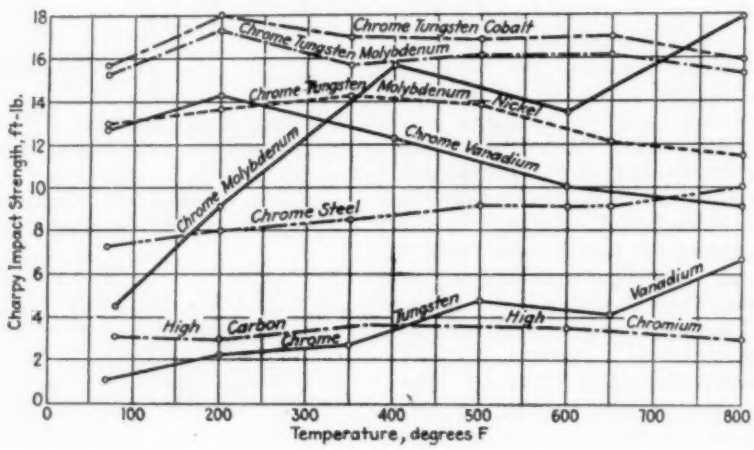
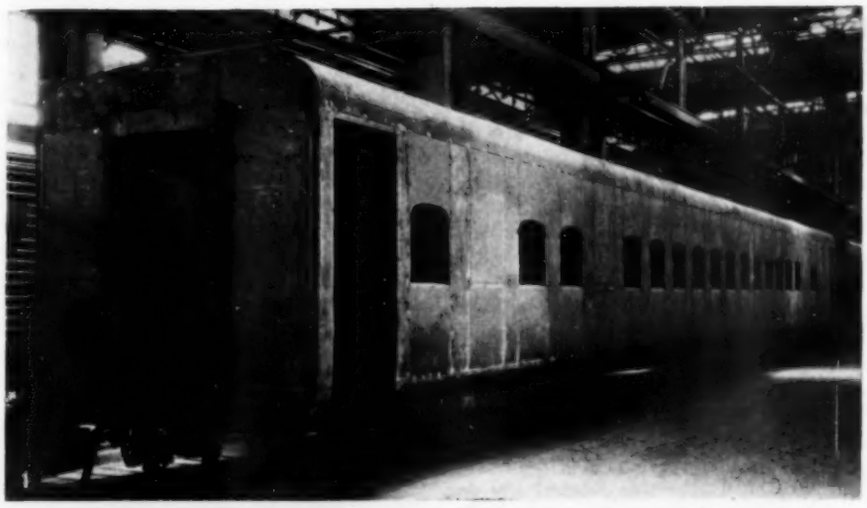
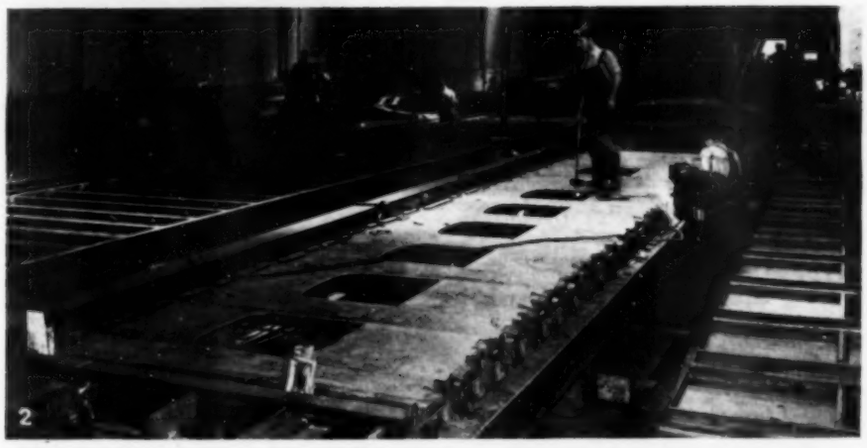
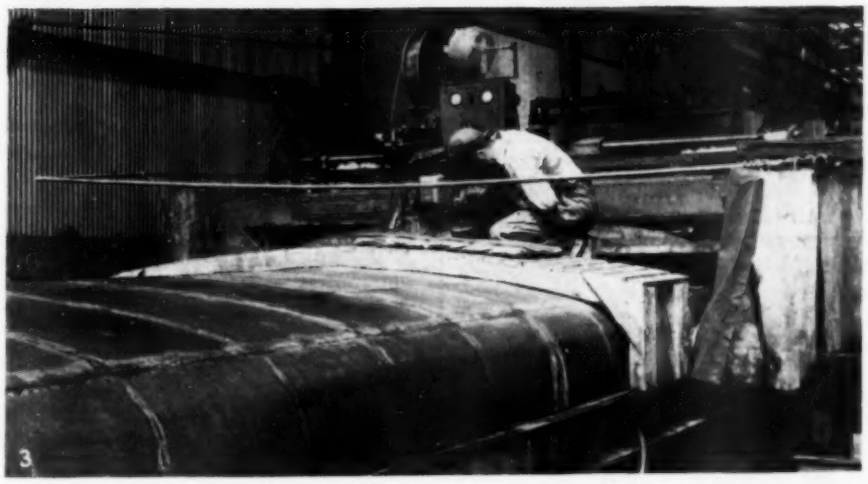


Table III—Composition of Steels Subjected to Impact Tests at Elevated Temperatures

	Chrome-vanadium	Chrome-tungsten-molybdenum (528)	Chrome-tungsten-molybdenum-nickel (531)	Chrome-tungsten-cobalt (527)	Chrome-tungsten-vanadium	Chrome	Chrome-molybdenum	High-carbon, High-chrome
Hardness, Rockwell C.	48.0	46.5	47.4	45.7	47	46.5	45–47	46
Composition:								
Carbon	0.46	0.28	0.33	0.34	0.32	0.90	0.50	1.50
Manganese	0.65			0.33	0.28	0.34	0.65	0.29
Phosphorus	0.013			0.018	0.019	0.011		
Sulfur	0.022		0.049	0.026	0.023	0.014		
Silicon	0.34	1.27		0.96	0.51	0.22		0.34
Nickel			1.45					
Chromium	2.65	4.77	4.53	5.11	3.23	3.45	0.70	12.00
Tungsten		1.01	1.15	5.36	9.24			
Molybdenum		1.50	1.06				0.35	1.00
Vanadium	0.20				0.47			0.75
Cobalt				0.50				







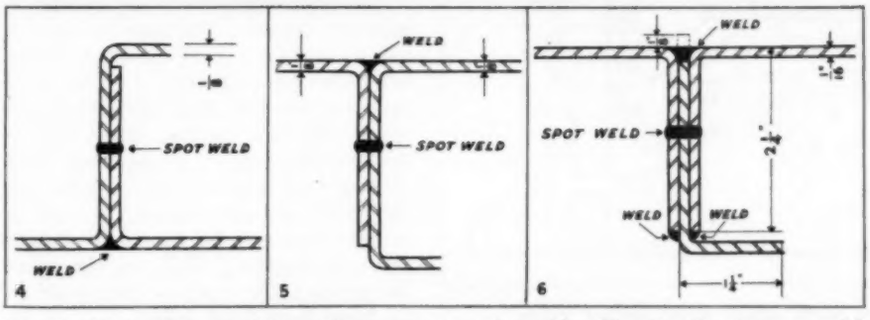


Fig. 4—Under frame with continuous automatic weld. Fig. 5—Continuous weld for side pans. Fig. 6—Filler strip is melted down between roof-pan flanges

35% Lighter Through Arc Welding

Savings of 35 per cent in weight were made possible by the use of arc welding in the construction of 52 streamlined air-conditioned steel passenger coaches which the Chicago, Milwaukee, St. Paul and Pacific Railroad is building for day and night service between Chicago and the Pacific Coast. The weight of each coach is approximately 96,000 lb. as compared with 146,000 lb. previously. There are none of the usual projections, such as window sills on the sides (Fig. 1). A built up design is the basis for the under-frame which includes the center sill, bolsters, buffer beams and body end sills. Fig. 4 shows a detail of the under-frame with a continuous automatic weld on the bottom or flush side.

The sides of the coaches consist of three different sizes of pans, Fig. 2, fabricated from ⅛-in. sheet. Structural strength is gained by forming flanges on the sheet. The pans are assembled in a jig, bolted down and welded automatically, one pan being welded to the other on the smooth outside face. These welds are continuous for the length of the pan. A typical automatic weld is shown in Fig. 5. After the pan corners are filled in with weld metal and after the temporary bolts are removed, the side structure is turned over and the flanges are spot welded together. In Fig. 2 can be seen one of the sides being welded manually at the flange ends.

The turtle-back roof, Fig. 3, consists of 1/16-in. sheet pressed into pans flanged on all four sides and also 7/16-in. pressed side plates. Steel strips ⅛ x 3-in. welded between the center pan flanges form the ridge pole. A strip projects above the surface and the carbon arc is used in the automatic welding machine to melt the strip down, thus providing filler metal between the flanges. A typical weld is shown in Fig. 6.

A water-cooling system in connection with each welding jig provides a continuous spray on the under side of a joint while it is being welded. Because the heat is prevented from penetrating into the flat surfaces of the pans, warping is reduced.

The welding equipment was supplied by the Lincoln Electric Company.

• IDEAS •
FROM PRACTICAL MEN

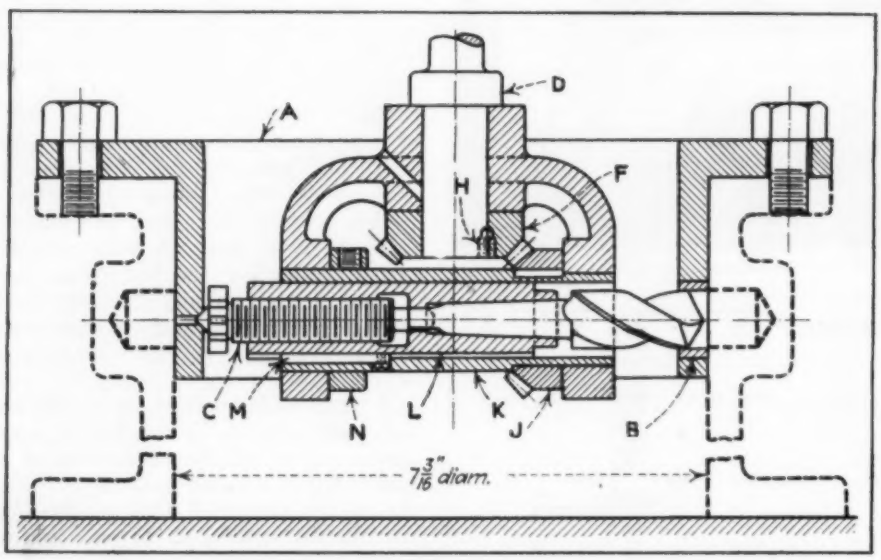
Fixture for Drilling Holes at Close Quarters

C. W. PUTNAM

We had many castings, such as the one shown in heavy dotted lines, requiring two ¾-in. blind holes to be drilled diametrically opposite each other from the inside of the bore. The distance from the center of the holes to top of the casting was to be kept to a limit of $\frac{1}{64}$ in. To lay out for the holes and drill them with a ratchet drill was not only too slow, but the holes could not be kept accurately within the limit required from the top of the casting, so we made the fixture illustrated.

The fixture *A* is a slip fit in the bore of the casting, being located and held by capscrews. Bushing *B* for guiding the drill is located in the fixture, and diametrically opposite a hole is drilled and countersunk for the conical point of the hand-operated feed screw *C*. The upper end of shank *D* fits the taper hole in the drill-press spindle and the lower part is a running fit in the fixture. Miter gear *F* is attached to the lower end of the shank by screw *H* and the mating gear *J* is keyed to sleeve *K*. Spindle *L* is a sliding fit in sleeve *K* and is provided with a keyway runing its entire length for the feather key *M*. Collar *N* is attached to the sleeve by a setscrew. Spindle *L* is drilled and reamed for the taper shank of the drill and is slotted for the tang.

Owing to the small diameter of the bore of the casting, a short drill was necessary. After one hole had been drilled, the fixture was rotated 180 deg. in the bore of the casting for drilling the opposite hole.



Blind holes diametrically opposite each other were drilled from the inside by a drill held in this fixture, using a vertical drill press

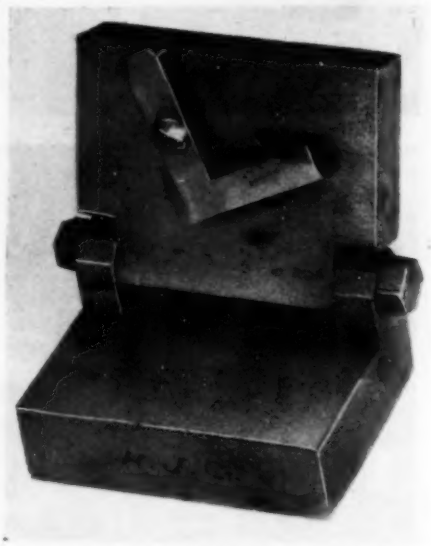
System in Servicing Chasers

HECTOR J. CHAMBERLAND

Of all cutting tools in the machine shop, none will depreciate faster than improperly ground chasers of dies and collapsing taps. Because of their positive lead, chasers remove more metal per revolution than do any other tools of their size.

There are several dependable designs of fixtures for grinding chasers on the market, but if a shop hesitates to make the investment, the tool illustrated can easily be made. It is simply a hinged angle plate having a small, adjustable square attached to its upright member. The chasers are located by the small square and are clamped to the upright member of the angle plate. The square is adjustable for right- and left-hand chasers and for the desired angle of chamfer, and the angle plate is adjustable for clearance. Once the correct adjustments have been made and the first chaser has been ground, the others in the set will be duplicates.

A decade or so ago, one set of chasers was used for threading all materials, but it is a different story today. It is cheaper to have several sets of chasers of the same thread than to be constantly changing the bevel, rake and clearance of a single set to suit different materials



Chasers located by the adjustable square and clamped to the upright member of the angle plate can be correctly ground for chamfer, rake and clearance

to be threaded. Chasers have certain characteristics that must be maintained throughout their servicing career if they are to prove a sound investment. When a set of chasers is purchased, and before it is used, it should be delivered to the chief inspector for a checkup for temper, chamfer and clearance angle, or for anything else connected with cutting properties. A duplicate of the findings should be given to the operator or to the foreman in charge of tool grinding. This procedure will save much inconvenience in case any trouble develops.

The surface grinder is dependable for grinding chasers. The correct wheel to use is a 6 or 7 x ½-in., 60-J Norton grade or its equivalent. If it is desired to give the chamfers an eccentric relief, the face of the wheel can be dressed accordingly. If the faces of the chasers need grinding, they can be lined up on a magnetic chuck. A rake or reverse angle can be ground by forming the corresponding angle on the wheel. In grinding, the depth of cut should not be more than 0.001 inch.

Kerosene should be used as a lubricant

in threading aluminum and its alloys. Mineral lard oil should be used for carbon and alloy steels. Cast brass and bronze need no lubricant, neither do rubber and fiber. Other brass and bronze stock will cut best with paraffin oil; so will copper. A good compound for threading cast and malleable iron can be made by mixing 40 gal. of water, 10 gal. mineral lard oil and 2½ lb. soda ash.

A good-sized book could be written on the care of chasers, but it is hoped that this condensed information will prove valuable to many small shops that believe threading tools can be ground as easily as can drills.

Producing Sharp Corners in Press Work

C. W. HINMAN

Some of the puzzling things to those who have not actually had to do them are how to bend sheet metal more than at a right angle; put initial tension in a flat spring or a clip; and how to give sharp corners to a drawn cup. In ordinary practice, the sharpest corner will have a radius greater than the thickness of the metal. In both drawing and bending it is necessary to round the corner of the punch slightly, otherwise it would act as a blanking or a trimming punch in drawing, and a cut-off punch in bending. Leaving the corner sharp in a bending or drawing die does not help, because the work "follows" the punch and would not fill in the sharp corner.

In thin metal, the taper of the cup and the radius at the corner are not so noticeable, but if the metal is say, ¼ in. thick and the depth of the cup is less than half its diameter, then both the taper and the lack of a sharp corner are distinctly noticeable. For instance, a brake drum drawn in this manner would be useless. Additional drawing operations might help in ironing the drum into a shape more nearly round but would not sharpen the corner because of the reasons given above. It is practically impossible to make an accurately round and straight-sided drum by drawing without applying a force that exceeds the elastic limit of the material and this is seldom possible with a punching of this size. The trouble lies in the difference in the action of the material in drawing both with and across the grain. This difference is much more noticeable with bessemer steel than with open hearth; with high or yellow brass than with low or red brass.

To get a sharp corner it is necessary to resort to what may be called the "hump" method. The application of the hump method is analagous to that which a carpenter uses when he wants a tight joint between the ends of two boards. He cuts his fitting board a trifle long and bows it slightly to get it into place. After the center is brought down flat by nailing, the board ends are tight together.

In drawing a brake drum, the faces of the punch and the die are so made as to make a concavity in the blank. This first-operation cup is then placed in a die that is the shape and size of the finished brake drum. This die has a heavy bottom to withstand the pressure. The punch is made to fit the inside tightly at the top, is straight, flat on the bottom, and has as sharp a corner as is possible without shaving the inside of the drum.

The diameter of the drawn drum, as measured along that of the hump or concavity is greater than the flat diameter of the die. As the punch descends, it strikes the hump and flattens it. This in turn crowds the metal into the corner of the die with a force sufficiently great to cause plastic flow or cold forging. A practically sharp outside corner and straight sides are the result. Even this treatment will not make the drum uniformly round and it is usual to take a light cut by turning or grinding for truing. This method is equally applicable to rectangular boxes, plates for push buttons, or any work where the metal can be so confined.

The most outstanding example of the hump method of bending is probably in making the hard-copper spring clip used in the ordinary knife-blade switch. The operations necessary to bend the sides beyond the vertical are shown in Fig. 1. These operations are particularly useful with work of spring steel and phosphor-bronze, where corner radii are necessarily large, and even then right-angle bends are difficult to make.

The hump method is not confined to drawn work. It is equally good for making odd shapes and bends. In Fig. 2 is a spring clip for holding papers and magazines in news stands. The hump is of irregular shape and is flattened to bring the wings beyond the vertical for tension, the principle being the same as in the other examples.

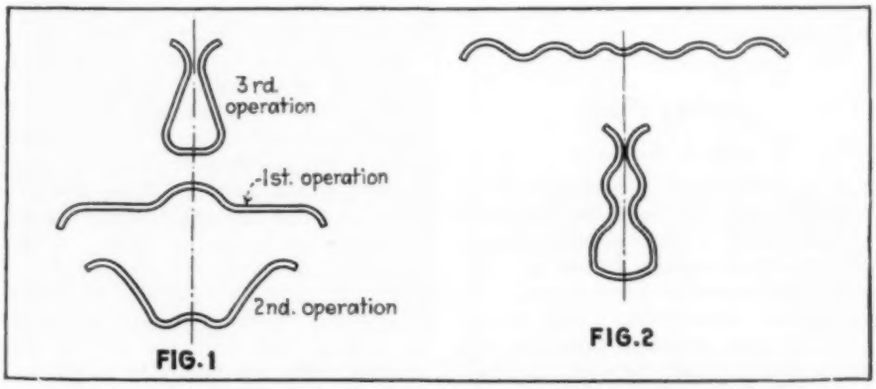
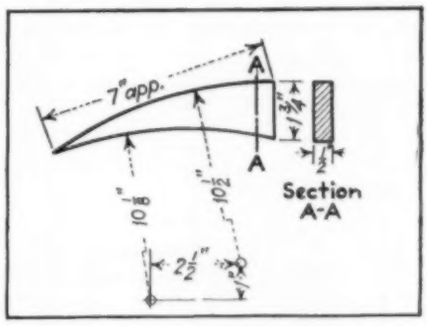


Fig. 1—Hard-copper clip for a knife-blade switch. Fig. 2—Spring clip for papers and magazines. In both articles the wings are brought in beyond the vertical by flattening the hump in the last operation

Tool for Removing Gib-Head Keys—Discussion

WM. C. ELLIS

In an article under the title given above (*AM*—Vol. 78, page 356), S. Lomas describes a tool for removing gib-head keys. I have had lots of experience in removing keys of this type and, although I have never used one of the type described by Mr. Lomas, I have never used anything better than the crescent-shaped wedge-type puller illustrated.



By making the wedge-type puller crescent shaped, its head is kept away from the face of the member from which the key is to be removed

The puller can be used for removing keys in almost any place except from the face ends of small bevel or miter gears. If made from 70 to 80 point carbon steel, hardened and tempered, it will stand up under severe use. Made

in the dimensions given in the sketch, it is suitable for keys from ⅜ to ¾-in. square. Larger or smaller sizes can be made in proportion. In use, care must be taken to hold the flat side of the puller on the body of the key, otherwise the key head may be broken.

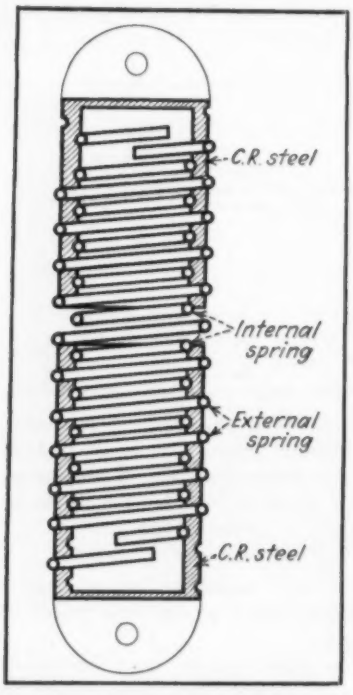
Fastenings for Tension Springs—Discussion

CHARLES KUGLER

In reading the article by Charles Brau, under the title given above (*AM*—Vol. 78, page 289), I was reminded of a method I used for fastening two tension springs, one inside of the other. The larger spring was not strong enough and was backed by a smaller spring of the same pitch inside of it.

Referring to the illustration, two pieces of cold-rolled steel were bored and threaded to suit the smaller spring, the outsides being turned and threaded for the larger one. A flat was machined on each holder and a hole was drilled in it for a screw for attaching it to the machine on which the springs were to be used.

The smaller spring was screwed into the internal threads and the larger one was screwed onto the external threads. This method of holding the springs permitted adjustment on the holders, on which they had more bearing surface than in the plates described by Mr. Brau.



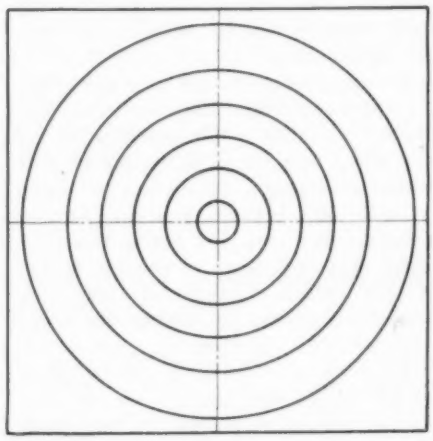
The fastenings for holding the two springs, one inside the other, are bored, turned and then threaded externally and internally

Center Punching on Scribed Lines—Discussion

H. C. RICKENBACH

President, Pittsburgh Stencil and Tool Co.

Referring to the devices described in articles under the title given above, by C. W. Castle and George J. Murdock (*AM*—Vol. 78, pages 193 and 485 respectively), the accompanying sketch illustrates a simple tool of transparent celluloid that will do the work. Cross



By laying the device on the work and bringing its lines into coincidence with those on the work, the center punch can be located at the intersection by the small hole

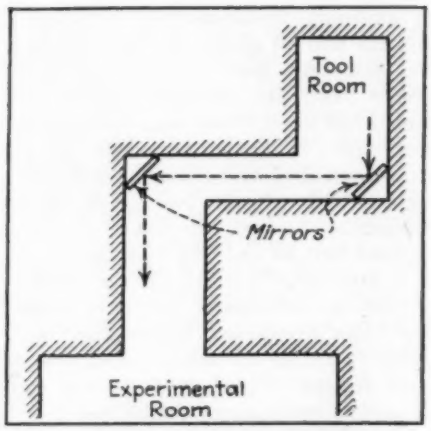
lines at right angles are scribed on the celluloid and a small hole at their intersection is for locating the extreme point of a center punch.

In use, the device is laid on the work and its lines are brought into coincidence with those on the work. When the adjustment is correct, the point of the center punch is placed in the hole and the center punch is struck a light blow with a hammer. The circles scribed about the hole as a center will enable the center punch mark to be checked, as well as the start of the drilled hole after the drill point has left its mark.

Safety First

JOHN A. HONEGGER

In a large plant, quite a number of minor injuries were being frequently reported. Most of them were shin scrapes or minor hand sprains caused by collisions with men or obstructions. Investigation showed that about 90 per cent of these accidents occurred in a communicating hall between the toolroom and the experimental department, simply because two right-angle turns in the hall obscured the view of what might



To one approaching a right-angle turn, a mirror set at an angle of 45 deg. in the inner corner gives a reflected view of the other leg of the angle

be coming toward one from the other legs of the angles, or what obstructions might be in them.

Mirrors of suitable size were set at an angle of 45 deg. in the inner corners of the turns, as shown in the illustration, so that anyone approaching a turn would have a reflected view of the other leg of the angle. From then on, accidents were almost zero. No doubt there are many places where the use of mirrors will prevent accidents.

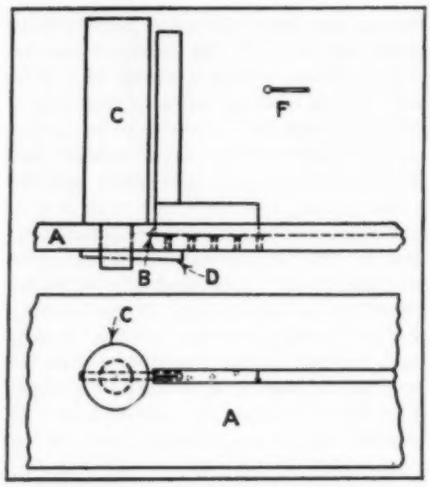
Testing Squares for Truth

JOHN E. HYLER

For testing squares by the method to be described, the necessary equipment is shown in the illustration. A channel is milled in the surface plate *A* and is afterward finished by grinding for a sliding fit for the beam of the square to be tested, taking care that the bottom of the channel is accurately parallel with the top of the surface plate. The end of the channel is undercut at *B*, so that it presents little more than a line. Small holes are drilled in staggered formation in the bottom of the channel to permit the escape of any dirt that may collect.

The cylinder *C* is carefully made and its shank passes through a hole in the surface plate. The shank is drilled and broached for the wedge *D*, tightening of which draws the shoulder of the cylinder tightly against the top of the surface plate, insuring that the cylinder stands accurately at an angle of 90 deg. to the surface plate.

The beam of the square to be tested is placed in the channel and is slid until its end contacts with the end of the channel. By the use of a ball-ended feeler, such as at *F*, in different places between the blade of the square and the cylinder, any deviations from truth



Any deviation of the square from truth can be determined by using the ball-ended feeler in different places between the blade and the cylinder

in the square can be quickly detected. If deviations are found, their magnitude can be determined by using a regular feeler gage in connection with the ball-ended feeler.

It goes without saying that the center line of the channel must be a continuation of a radial line from the cylinder, and that the beam of the square must not be cocked in the channel during the test.

Grinding Cylinder Heads for a Steam-tight Fit

A. ROBESON

To eliminate the back-breaking labor in grinding cylinder heads, the back shop of a small railroad has employed

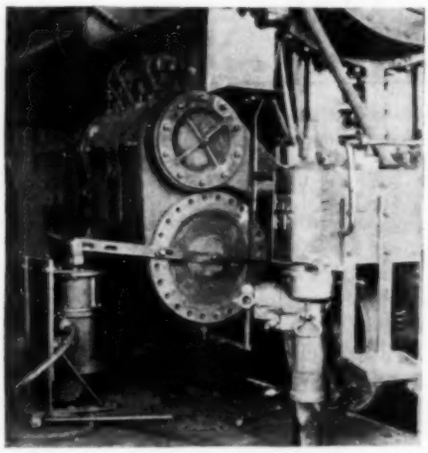


Fig. 1—The cylinder head is oscillated by the piston rod in the steam end of an air pump, using compressed air for power

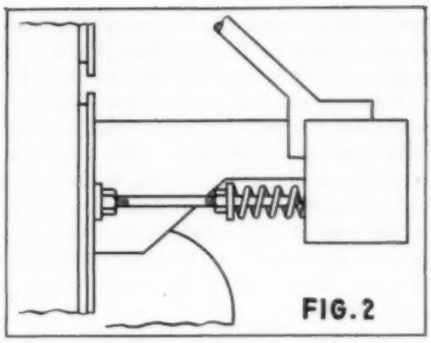


Fig. 2—The cylinder head is pressed against the cylinder by a spring rigging between the head and the bumper of the pilot

the steam end of an air pump to oscillate the cylinder heads, using compressed air for power.

A lever connects the cylinder head with the piston rod of the pump, as shown in Fig. 1. To keep the head pressed against the cylinder, the spring rigging shown in Fig. 2 is used. One end of the device has a stiff spring bearing against the bumper of the pilot. A rod with suitable nuts and a washer connects the spring with the cylinder head. Pressure of the spring is adjusted by tightening or loosening the nut on the spring end of the rod.

Transferring Mechanism for Turret-Type Machines

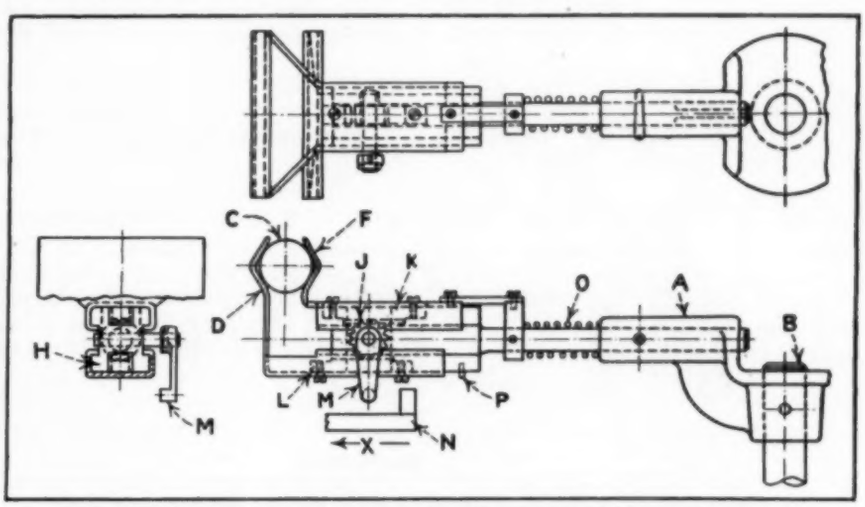
F. H. MAYOH

A device for transferring packages from one station to another in a machine of the turret type is shown in the illustration. The entire unit is carried by bracket *A*, which is attached to upright shaft *B*. When this shaft is rotated a quarter of a revolution by the machine, the unit is turned through an arc of 90 deg. and the work held at *C* is transferred to the next station.

The work-holding jaws *D* and *F* are made of light sheet metal bent to the desired shape. The horizontal tails of both jaws fit over the grooved, rectangular bar *H*, as may be seen in the small view at the left, and are moved in opposite directions simultaneously by gear *J* meshing with racks *K* and *L*, which are integral with the jaw tails. Gear *J* is operated by lever *M*, which, in turn, is actuated by sliding member *N*, connected to a mechanism of the machine (not shown) pushing against it. When sliding member *N* is moved in the direction of the arrow, its vertical part contacts with lever *M*, rotating gear *J* and opening the jaws for endwise reception of the work.

As sliding member *N* moves to the right and out of contact with lever *M*, spring *O*, acting through members connected to the tail of jaw *F*, pushes that jaw to the left, rotating gear *J* and drawing jaw *D* to the right. Thus both jaws are closed on the work and hold it concentric with the feeding member (not shown). Shaft *B* is then rotated and the work is conveyed to the next station where another sliding member similar to *N* pushes against lever *M* and opens the jaws for the removal of the work by another mechanism (not shown). After work has been transferred to each station, the entire unit is returned to the starting point.

If, through mis-functioning of the machine, no work is delivered to the jaws, the tail of jaw *D* strikes pin *P* and prevents the jaws from closing enough to swing lever *M* so far that it can not be engaged by sliding member *N*. The light weight of this device keeps the shock incidental to its operation at a minimum, so that its action is smooth at high speed.



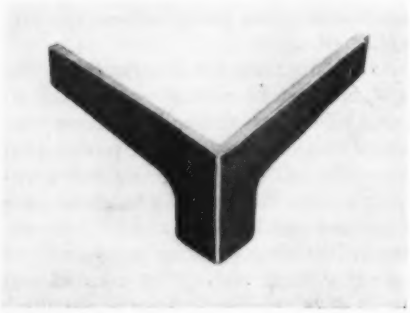
This simple mechanism is intermittently operated by moving parts of the machine and picks up work and transfers it station to station

A Shoulder Square

MALCOLM K. PARKHURST

Inability to see around the edges of things in using the ordinary square led me to make the tool illustrated. It was made from a section of square steel-tubing, each blade being 1½ in. long. In use, it has proved to be most helpful in determining points or positions lying in two planes that must be brought into alignment with reference to a third plane, all at right angles to one another.

A larger tool of the same kind, made from a casting would be useful for the patternmaker.



This two-way square will enable the toolmaker to align points or positions lying in more than one plane and at right angles to one another

Adjusting Checknuts Used as Stop Collars

J. E. FENNO

In adjusting checknuts used as stop collars on boring bars and the bars of counterbores, it is difficult to move one nut without disturbing the setting of the other, owing to the frictional contact between them. If, however, a flat is milled on the threads of the bar, as at *A*, and a washer having a flat in the hole to fit the flat on the bar, as at *B*, is interposed between the nuts, one nut can be slacked off without disturbing the setting of the other. When the desired adjustment has been made, the slack nut can be brought up against the washer without moving the other nut.

Another method is to cut a keyway along the threads and make the washer with an intergral key. Still another method is to drive a pin in a hole drilled in the bar and put a keyway in the washer. The diameter of the pin must not be greater than the thickness of the washer minus the axial adjustment required.

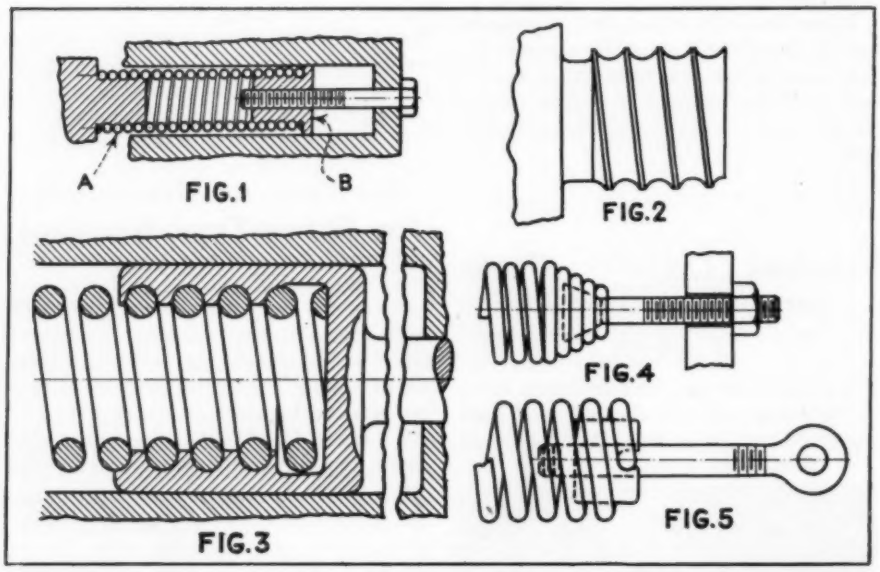
Fastenings for Tension Springs–Discussion

ADAM FREDERICKS

The article by Charles Brau under the title given above and the discussion thereon by Noel Deisch (*AM*—Vol. 78, pages 289 and 546 respectively) have brought to mind several methods of fastening tension springs other than those described by those authors.

In Fig. 1, a closely-wound spring is threaded onto the stud end *A* and onto the round nut *B*. The crests of the threads on both parts are slightly flattened, as shown in the enlarged view in Fig. 2. If the spring is wound on a stud end having threads of a greater pitch than the diameter of the wire, as in the enlarged view in Fig. 3, the threads can be cut deeper and the crests can be made flatter.

A common fastening is illustrated in Fig. 4. One end of the adjusting screw is upset to a taper and fits into the closed end of the spring. When rotating motion is involved, as in Mr. Brau's case, the rod end threaded into a round nut, as in Fig. 5, is a simple method. The nut is slotted on one side of the hole to receive the turned-in end of the last coil of the spring.



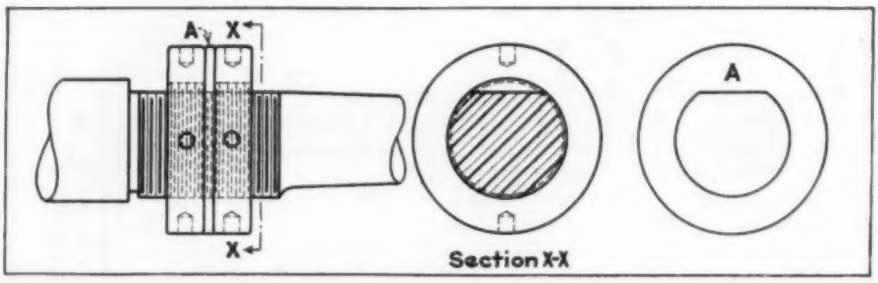
Many methods are employed for fastening the ends of tension springs, but here are some that are different from those described in previous issues

Cutting a Quiet Gear

O. D. BRADSHAW
Fredericton, New Brunswick, Canada

We had to cut a 4-pitch gear having 19 teeth to replace a gear meshing with one having 95 teeth in a speed reducer. As we had no facilities for grinding the teeth, rather than risk possible distortion in hardening a steel gear, we made the gear of phosphor-bronze. Not having cutters in half-numbers for cutting a given number of teeth, the gear was cut with a No. 6 cutter for from 17 to 20 teeth, checking it with a gear-tooth vernier. When assembled in the speed reducer the gears were noisy. The gear we had cut was taken out and was recut or shaved in an attempt to make it run more quietly.

A tooth, four times the actual size of a 4-pitch tooth, was generated on paper and a radial line through the center



A washer having a flat in the hole to fit a flat on the bar, and put between the nuts, will permit one nut to be slacked or tightened without disturbing the other

was drawn. This drawing was reproduced to actual size on the face of a tool to be used in a small planer, using an engineer's suspended pantograph and scribing the center line deeply. The tool was machined to the scribed outline, using a magnifying glass; then it was heated in a lead bath for hardening.

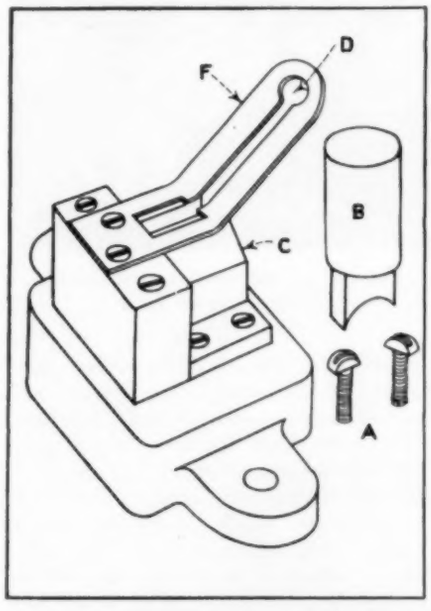
The gear was mounted on a mandrel held between the index centers in the milling machine and the bottoms of the tooth spaces were slightly deepened with an 8-pitch No. 1 cutter to give clearance for the planer tool. The center line of the tool was set square with the planer table and the index centers were transferred to the planer. The gear and its mandrel were held between the index centers and the tool was centered with the gear and set to the correct tooth-depth. Each tooth was then retouched with the planer tool. Upon assembly in the speed reducer, the gears ran quietly.

Press Tools for Trimming Round-Head Machine Screws

CHARLES H. WILLEY

Because of a change in design in one of our products, it was necessary to trim the heads of a large quantity of round-head brass machine screws, as at *A*. The tools for this work are shown in the illustration, of which *B* is the punch and *C* the die.

The screws were fed to the die by inserting the heads through the opening *D* in the inclined slide *F* and pushing the bodies into the slot, the under sides of the heads resting on the top of the slide. They then slid to the die by gravity. The inclined slide is mounted on a block and is at a sufficient height above the die to permit the chips to fall away over its angular sides. Production was at the rate of 2,000 per hour.



Screws are fed to the die by inserting the heads through the hole in the inclined slide and pushing the bodies into the slot. Gravity does the rest

NEW BOOKS

★ ★ ★

BEYOND THE NEW DEAL. *By David Lawrence, editor "The United States News." 321 pages 6x9 in. Bound in cloth boards. Published by Whittlesey House, McGraw-Hill Book Co., Inc., New York and London. Price $2.50.*

From his twenty-five years in Washington watching the political turmoil Mr. Lawrence has acquired a certain amount of disinterestedness in his appraisal of the New Deal. This is particularly refreshing as a contrast to the fervid attacks on and defenses of the New Deal that are part and parcel of the current political campaign.

In the first of the four parts into which he has divided his book Mr. Lawrence traces the course of the depression and its effect on national policy and public sentiment. One of his best chapters is the one on the Price of Prejudice, where he shows how we demanded a scapegoat and found it in the banker after the bank holiday, and how the vengeful legislation passed in the heat of passion has reacted to keep all of us from prosperity. He is particularly lucid in his discussion of the factor of industrial obsolescence when he suggests the alternative to lavish expenditures for public works.

In the second part of the book Mr. Lawrence claims that we have chosen world trade and the broadening of international relationships as against a narrow nationalism, and that we must therefore take the lead if we are to get our own 10,000,000 unemployed back to work. He says further that we have always come back to gold as a currency base, that we always shall, and that when we do we can expect a return of better times.

Part three considers the attempts to upset the Constitution and the measure of success attained by the radicals. He warns of the danger of dictatorship that lies in some of the emergency legislation.

The final section starts with the premise that the New Deal is just as politics-ridden as any of our older deals and needs a house cleaning just as much. As remedies he suggests provisions for recall of members of Congress and the Cabinet, and for all the world a new nationalism that will co-operate for peace.

INDUSTRIAL MARKETING — *By John H. Frederick, assistant professor of commerce and transportation, Wharton School of Finance and Commerce, University of Pennsylvania. 401 pages, 6x9 in. Indexed and illustrated. Cloth binding. Published by Prentice-Hall, Inc., 70 Fifth Ave., New York, N. Y. Price $3.50.*

Many are the problems that rise to plague the maker of industrial goods in the sale of his products. Should he sell direct or through agents? What kind of an organization should he have? Where is his market and how large is it?

A few years ago the manufacturer of industrial products would put a new equipment or supply into production and then instruct his force to sell it. Today's conditions have made this direct procedure obsolete. The factors affecting industrial marketing are too many and too complex to be thus ignored.

Practically every maker of industrial products must weigh at one time or another the considerations affecting the sale of his goods that are discussed in Professor Frederick's book. In defining these considerations, analyzing them and evaluating their importance, the author has performed a distinct service. He has chosen for his field those manufactured or semi-manufactured products that are supplied to industrial consumers, a sector of the nation's output that has received far less attention than its two flanking fields, raw materials and household consumer goods.

In addition to the many phases of selling set-up and technique, Professor Frederick discusses the uses of sales aids such as catalogs, sales manuals, motion pictures, industrial shows, and industrial advertising. His treatment of the last named activity is comprehensive, covering the selection of media, direct mail, house publications, advertising agencies, the use of trade marks and other angles.

The volume draws freely from books and articles on the subject. These references are contained in foot notes and in a bibliographical note at the back of the book.

The presentation is timely in that it envisions industrial marketing under the provisions of the National Industrial Recovery Act. In this connection the influence of trade associations and code authorities as well as that of the government is summarized.

SHOP EQUIPMENT NEWS

Warner & Swasey No. 2 Turret Lathe

A 1-in. bar capacity turret lathe capable of 1,480 r.p.m. and with an improved bar feed mechanism is announced by the Warner & Swasey Company, Cleveland, Ohio. The turret lathe is equipped with a six-speed, all-geared head. A two-speed motor makes twelve speeds possible with a range from 67 to 1,480 r.p.m. In spite of the high speeds, the machine can be operated within close limits because of the rigid construction.

The entire head is anti-friction bearing equipped. All gears are of hardened alloy steel and have ground teeth for silent operation. The head has sufficient power for heavy duty work with cemented tungsten-carbide tools. A single-pulley, constant-speed drive makes the full horsepower available at all six speeds. The forward and reverse multiple-disk clutch has ample area to allow reversing at high speeds. A four-to-one ratio, high-low clutch makes possible the instant shifting from turning to threading or reaming speeds, or vice versa, without stopping the spindle.

Lubrication of the entire head is by splash. The spindle is mounted on double-row, precision Timken bearings at the front end and a preloaded precision straight roller bearing in the rear. All other shafts run on roller bearings.

An automatic circumference binder ring, which permits the clamping and indexing of the hexagon turret by a rotation of the turnstile, is incorporated in this turret lathe. This is an important factor in high speed work where the reduction of the handling time becomes an item.

The high speeds and the ease of operation of this turret lathe make it an efficient machine tool for use on very small work, as well as for second-operation work in automatic bar departments. Cemented tungsten-carbide tools may be used on cast iron, steel, non-ferrous metals or non-metallic materials.

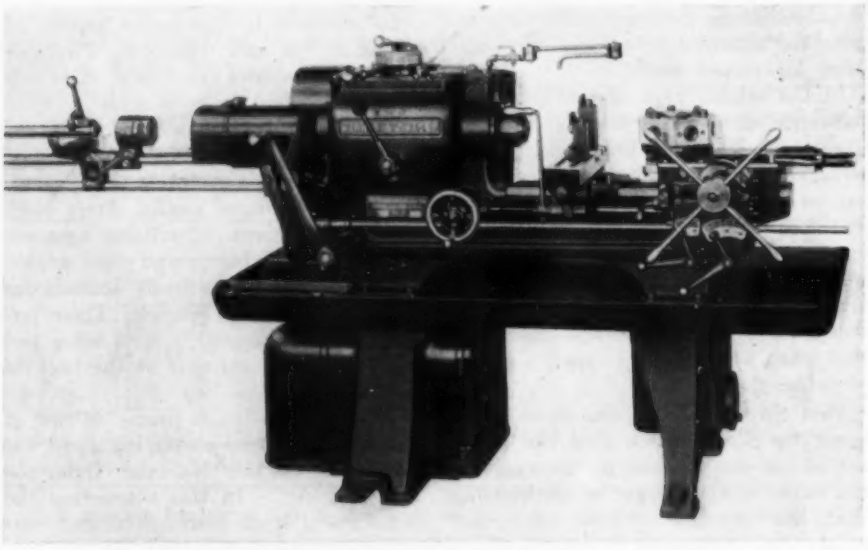


Fig. 1—No. 2 Six-Speed Turret Lathe with Ratchet Bar Feed

Since high-spindle speeds are essential, a combination friction finger and ratchet bar feed has been designed, which speeds up the operation and provides for the safety of the operator. Bars up to $\frac{5}{8}$-in. diameter are advanced with a friction finger lying immediately behind the collet inside the spindle and inclosed throughout their length. This prevents buckling or bending of the bar through centrifugal force, and thus protects the operator and eliminates vibration. The use of filler tubes assures balance at high speed by centering the bar in the spindle. Bars above $\frac{5}{8}$-in. diameter are fully inclosed at the rear end, being exposed only for the length of the ratchet feed stroke between the spindle end and the bar support tube. By using the ratchet feed for the larger bars, it is possible to have a maximum 1-in. capacity with a spindle small enough in diameter to stand extremely high speeds.

Another feature of this machine is the possibility of arranging the cross-slide as a lever-feed or screw-feed type, or a combination of the two, by substituting the required parts in the cross-slide.

The power feed has been designed for continuous operation at high speeds. The initial reduction from the spindle is by V-belt. The first reduction gear, made of hardened alloy steel, has ground teeth to insure silent operation. The entire train is mounted on anti-friction bearings and all the apron gears are of hardened alloy steel. Lubrication is by grease, which cannot be readily washed away by the coolant. The hardened worm runs in an oil bath, and is completely shielded to prevent oil loss by centrifugal force.

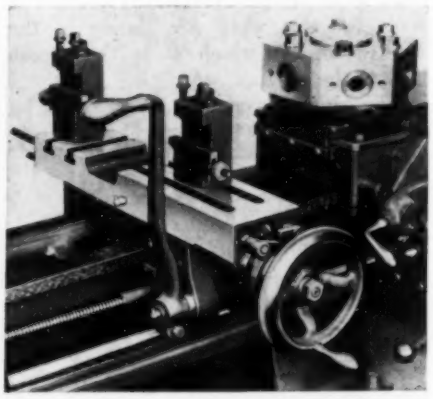


Fig. 2 — Combination cross-slide, lever or screw feed

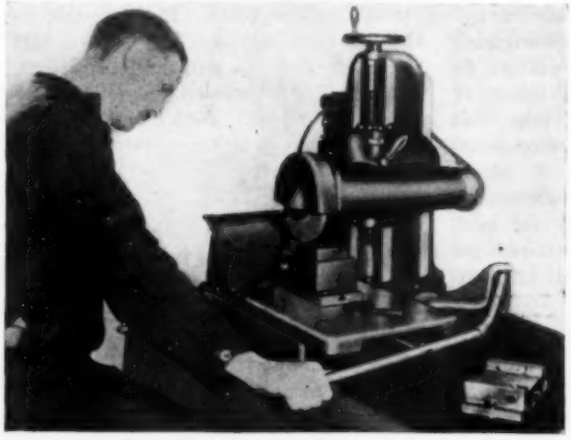
The six feeds for the hexagon turret range from 0.003 to 0.030 in. There is an option of two change gears which will reduce the feeds by one-half.

Diamond 8x4x10-Inch "Knee Action" Surface Grinder

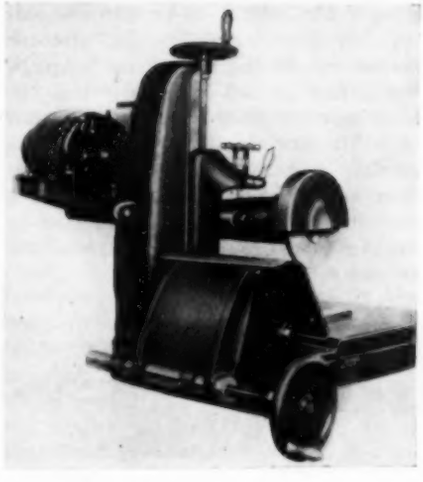
For production and toolroom use, the Diamond Machine Co., 9 Codding St., Providence, R. I., is offering an 8x4x10-in. "Knee Action" surface grinder which departs from conventional design. The intermediate table has been eliminated, but the design of the spindle housing and saddle prevents play and vibration. The table rests directly upon a ground plane surface on the bed and is guided longitudinally and laterally by the "Knee Action" control. This is the hinged member shown at the rear of the machine in Fig. 2. There is no play to affect the thickness of the work and there is only one oil film subject to the grinding pressure as contrasted with two or more in conventional design. The way is covered by guards in all positions of the table.

The upright is of heavy construction and is provided with three ways on which the saddle is moved vertically by a handwheel. After coarse adjustment of the wheel to the work, the saddle is clamped rigidly. The micrometer graduated fine feed is then utilized. The saddle carries the spindle housing on special hinged bearings, that are completely guarded. The spindle itself is equipped with a plain taper front bearing and a rear ball radial thrust bearing and with spring take-up adjusting means for both bearings.

The table has a platen with one T-slot for $\frac{3}{8}$ in. bolt. It has longitudinal movement by hand lever at right of the machine (see Fig. 1) and lateral movement by the handwheel at the left of the machine, Fig. 2. Both longitudinal and lateral movements are sufficient for the wheel to clear the platen. A rubber-mounted, $\frac{1}{4}$ hp. motor drives the spindle by V-belt with automatic take-up. Magnetic chucks 8x4 or 6x4 in. can be furnished. A mechanical fixture with a suitable opening for standard punches and dies within the capacity of the machine and also with an arrangement for holding the truing diamond, can be supplied. The grinder can be used on a bench or mounted on a floor column. A 7-in. wheel with $\frac{1}{2}$-in. face is used.



Left — Fig. 1 — The table rests directly on the ground bed, and longitudinal movement is controlled by the hinged lever



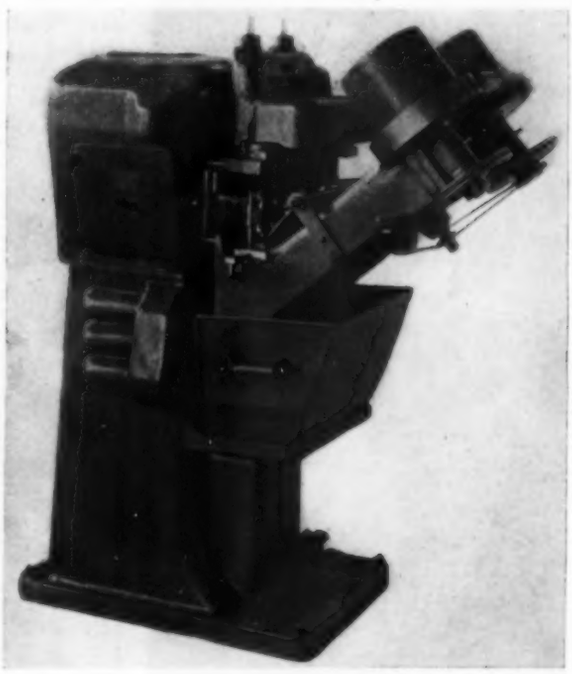
Left — Fig. 2 — "Knee Action" is secured by the hinged member. Lateral table movement is obtained with the handwheel

Globe Type A Hopper-Feed Multi-Spindle Machine

The Globe Tapping Machine Co., 751 Central Ave., Bridgeport, Conn., has developed an automatic hopper-feed machine known as the Type A. It has a production range from 120 to 180 pieces per minute of single-hole parts, either tapped, drilled, countersunk, threaded or hollow milled. Rate of production depends on the size of the part, the size of the tap and depth of the thread. Ordinary commercial straight-shank, high-speed taps are used.

The accompanying illustration shows the Type A machine with two hoppers, six chutes and six ball-bearing tapping spindles. This machine was arranged for special sleeve nuts having a 10-24 thread, $\frac{7}{8}$ in. deep. A quantity of nuts is dumped into the two hoppers, and as they revolve the nuts are fed down through the six chutes and are tapped and ejected at the rate of 150 per min.

Several different types and sizes of parts can be handled if necessary, merely by changing the chutes and an adapter ring in the hoppers, and relocating the spindles which are adjustable. Spindles are so constructed that the tap



Right — Single-hole parts, even in different shapes and sizes at the same time, can be tapped, drilled, countersunk, threaded or hollow milled at 120 to 180 pieces per minute on this six-spindle machine

follows its own lead, permitting the use of different sizes on the same machine. The drive is from a 2-hp. motor mounted on a tilting plate in the rear base. All shafts are mounted on anti-friction bearings. A tank is cast integral with the pedestal and holds coolant which is supplied to the taps by means of a gear-driven pump.

The machine should not be confused with the dial-type machine built by the company.

Van Norman No. 12 Milling Machine

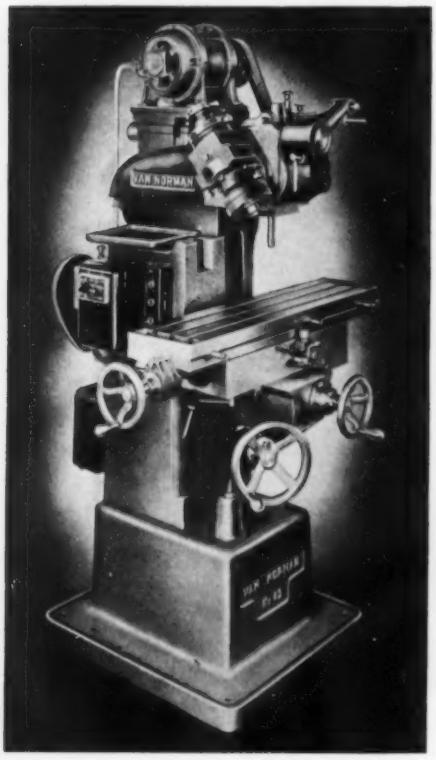
A milling machine incorporating a number of advanced features designed for modern toolroom and pattern-shop conditions, has been announced by the Van Norman Machine Tool Company, Springfield, Mass. The machine, called the No. 12, retains the adjustable cutter head and movable ram typical of all Van Norman millers. The cutter head is adjustable not only for horizontal and vertical milling, but also for angular settings over a 90-deg. range. With the subhead attached to the face of the main head, almost any angular surface can be obtained through the full travel of the table, using a standard right-angle cutter.

The saddle and table are considerably heavier than former millers of corresponding range. The knee is a box type and other parts have been stiffened to give greater rigidity than in previous machines of the same size, allowing it to handle heavier work and at higher speeds.

All cutter-head drive gears are contained within the ram, the ram and the cutter head making up one complete unit having no drive connection with the rest of the machine. Anti-friction bearings are used throughout the machine. Standard cutter speeds range from 70 to 1,465 r.p.m. and higher speeds can be obtained if desired.

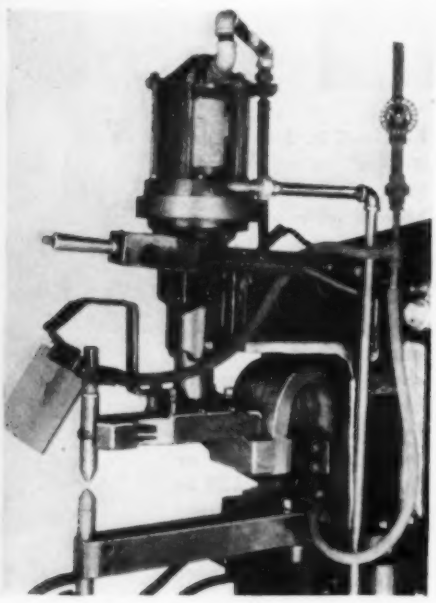
A motor is mounted on the top of the ram and the drive from the motor to the cutter-head drive gears is by a heavy V-belt. A separate motor, mounted at the back of the machine below the feed gearbox, serves for the table feed.

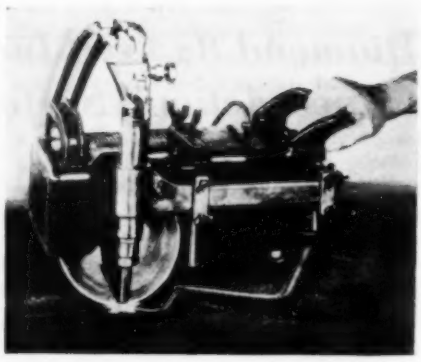
Complete information on the machine is presented in a bulletin released by the manufacturer.



Hanna Pressure Cylinder for Welding Machines

The Hanna Engineering Works, 1765 Elston Ave., Wicker Park Station, Chicago, Ill., has adapted its air or hydraulic cylinders for use in modernizing manually operated resistance welders. A cylinder is mounted on the flange of the barrel surrounding the ram that closes the electrode. A foot-operated valve enables the operator to secure the necessary pressure on the electrodes. Uniform pressure is secured for each weld, and more welds are secured per day. The cylinder is available in diameters of 3 in. and larger.





Airco-DB Tractograph Oxyacetylene Cutting Machine

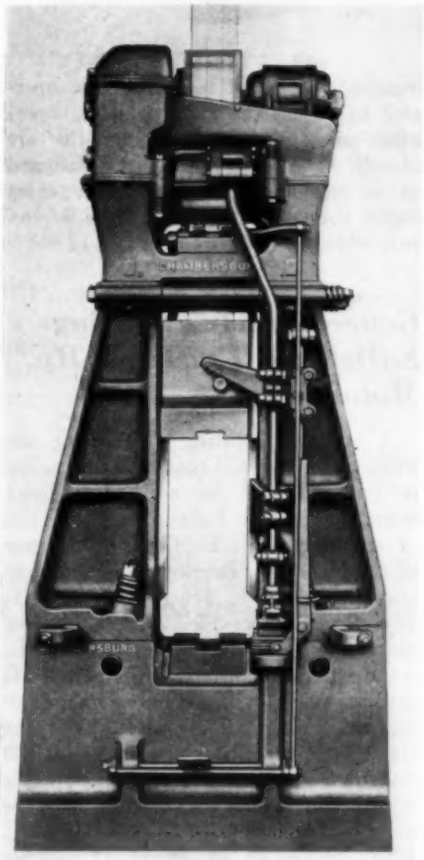
A small motor-propelled oxyacetylene machine for cutting steel plates and slabs up to 2 in. in thickness has been developed by the Air Reduction Sales Co., 30 East 42nd Street, New York, N. Y. Known as the No. 1 Airco-DB Tractograph, this machine measures 7¼x8¼x16 in. and weighs only 48 lb. and provides means for cutting steel plates into shape having straight, circular or irregular outlines and extending over practically unlimited areas. As it travels it is guided by hand along the desired contour laid out and scribed directly on the plate. It is possible for the operator to make the machine turn sharp corners. In addition the Tractograph will cut beveled as well as perpendicular edges. With the radius rod in place it will automatically cut arcs or complete circles.

"Chicago" Portable Electric Grinder

The Chicago Wheel & Mfg. Co., 1101 West Monroe St., Chicago, Ill., has announced a portable electric grinder of the universal type. The tool weighs 4 lb., operates at 17,000 r.p.m., and will drive a 2-in. wheel. A built-in, viscous-type air filter keeps dust and abrasive matter out of the motor and bearings. Ventilation is not impaired when the filter becomes loaded with foreign matter. The cast-aluminum motor housing extends over the motor shaft and air filter and is encased with an insulating cushion grip. The tool is designed to work at an angle and to get into and around corners.

Chambersburg Model J Drop Hammer

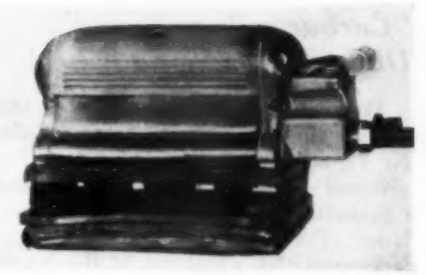
The Chambersburg Engineering Co., Chambersburg, Pa., has introduced an improved board drop hammer, Model J, having frames and anvils made of Cecolloy (*AM*—Vol. 78, page 657). This nickel-molybdenum alloy has damping properties similar to ordinary cast iron, but has a tensile strength in excess of 50,000 lb. per sq.in. The motor-driven head consists of two sections which house the eccentrics, rolls and



driving mechanism, with a cap to close the gearbox. The driving mechanism is practically a spur-geared reducer, the gears being of heavy pitch with wide face. Heavy-duty Hyatt roller bearings are employed. The motor is rigidly mounted on the head and connected to the driving mechanism by a flexible coupling.

The anvil has a ratio of 20 to 1 to the falling weight, and maintains alignment by non-twisting, non-rocking frame-to-anvil connections, and by the company's cross-guided joint. The frames are non-rocking members with integrally cast guides, the V's being longer and widely spaced. The front rod is protected from vibration by a steel-armored rubber bushing at the top and by a wide-faced steel shoe plus padding at the bottom. A rod giving universal and quicker adjustments replaces the usual notched rack for adjusting the releasing lever position.

Sterling "Speed-Bloc" Sander



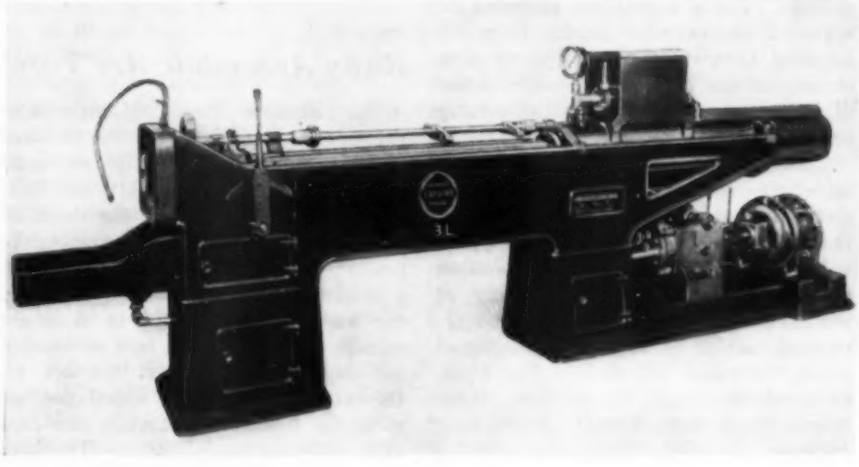
An air-operated portable sander has been developed for industrial use by the Sterling Products Co., 314 Curtis Bldg., Detroit, Mich. The "Speed-Bloc" sander weighs 7 lb., operates on compressed air at 70 lb., using 6 cu.ft. per min., and can be used on metal surfaces. The sanding motion is an oscillating or reciprocal one. Stroke travel of the pad is 1¼ in. at the rate of 2,500 to 3,000 oscillations per min. The pad device is made of rubber and felt and is bridged in such a manner as to be flexible. Thus, it is applicable to convex or concave surfaces, along moldings and in places difficult to sand. The size of the device is 7¾ in. long, 4¾ in. high and 3¾ in. wide. It is fitted with a water connection to be used for wet sanding.

LaPointe Variable-Speed Hydraulic Broaching Machines

Horizontal, variable-speed hydraulic broaching machines are now being built by the LaPointe Machine Tool Company, Hudson, Mass., in eight sizes, the capacities ranging from 15,000 to 73,000 lb. The No. 3L machine illustrated has an infinite range of cutting speeds from 0 to 24 ft. per min. on the working stroke and a fast return at 60 ft. per min., unless otherwise specified. The return speed of the ram can also be varied from 20 to 180 ft. per min. if desired. Maximum overall length of the broach is 56 in., and the maximum travel of the ram is 52 in.

The cutting speed may be varied without affecting the return speed, and the return speed may be set according to the rate of speed at which the operator can handle the work. Speed changes can be made while the machine is running or stopped. The control arrangement is mounted on a shaft running parallel to the crosshead ways. An automatic stop controls the length of stroke. The stop is of the spring and plunger type and requires no wrenches for adjustment.

The draw head, or sliding head, is fitted with bronze shoes to reduce wear, while the ways on which the sliding head fit are made of steel and are removable. Coolant for the broach is applied by a small pump which is driven from the main drive shaft of the pressure pump. The No. 3L machine has a face plate 14 x 16 in., the hole being 5 in. in diameter. Distance between the ways is 6 in. A 7½-hp., 900-r.p.m. motor is recommended.



"Carborundum Brand" Diamond Dressing Wheel

At the National Metal Congress, the Carborundum Company, Niagara Falls, N. Y., announced and demonstrated a diamond dressing wheel for shaping and conditioning the hard cemented carbides. The diamonds used in the manufacture of this wheel are of the South African variety and are crushed and graded. Three grits are supplied—90 grit, the coarse; 220 grit, the fine; and 400 grit, the extra fine. With this range of grits it is possible to do the comparatively rough grinding or stock removing with the coarse wheel, to produce an edge superior to a lapped edge with the fine wheel, and to create a very keen edge and a mirror surface finish with the extra fine wheel. Stocks are available in 6 and 7 in. diameters for peripheral and side grinding.

The manufactured abrasive "Carborundum Brand" silicon carbide is rated in hardness at 9.17 on the Moh's scale. The cemented carbides are rated at from 9.12 to 9.14, and the diamond at 10. Thus there is very little difference in hardness between the hardest of manufactured abrasives and the cemented carbides. Enough difference exists, however, that the specially developed and bonded "Green Grit" Carborundum Brand wheels have been marketed previous to the introduction of the diamond dressing wheel. However, the demand for greater speed and production called for a diamond wheel as a companion product.

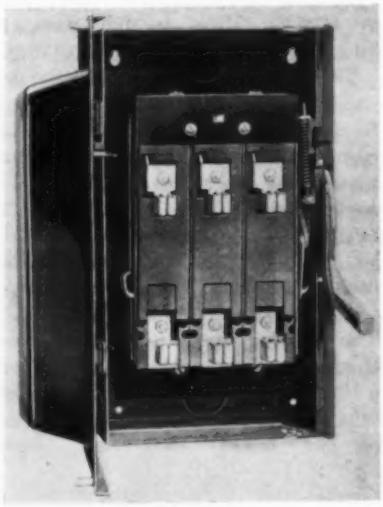
Because the regular or solid wheels with diamonds as the abrasive would be prohibitive in cost, a composition form or backing was devised to which is applied a coating of the diamonds and the bond. This layer, about $\frac{1}{8}$ in. thick, is applied to the side of the wheel form for side grinding and to the periphery of the form for cylindrical and other types of grinding. The wheels are then baked by a specially developed process. These wheels are balanced to within a fraction of a gram. They are so hard that it is impossible to turn or dress them to size. The wheels are of such nature as to require that cutting or grinding be done wet.

Tests have shown that in the grinding of pure cemented carbide, the coarse-grit diamond wheel will show a stock removal thirteen times greater than with the specially developed standard abrasive wheel. On the grinding of mounted tips, that is, grinding the cemented carbide as well as the steel tool stock, the wheel will remove four times as much material. In addition, these wheels have been found of value in cutting industrial diamonds, such as used in boring bars. In laboratory tests the diamond wheel cuts the stones at high speed, in some instances taking off as much as 0.008 in. in four minutes, a task that would take hours on a lapping disk.

By using a fine grit wheel the long tedious work of lapping cemented carbide tools is eliminated. The wheel produces a mirror finish; the tips have clean, straight edges without nicks and the tool faces are flat. The tools are ready for use after grinding on the fine wheel without resorting to lapping.

Square D 100- and 200-Amp. Switches

The Square D Company, Switch and Panel Division, Detroit, Mich., has added 100- and 200-amp. switches to the Square D 50,000 line. These switches are quick-make, quick-break types with interlocked covers and elevated removable bases for easy wiring. The inclosures are small. Either standard sheet-metal boxes or cast aluminum inclosures are standard, and cast-iron inclosures are optional.



Roffy Automatic Arc Torch

The Electric Torch Manufacturing Co., 2442 San Pablo Ave., Oakland, Calif., is marketing a "Roffy" automatic torch which operates on 110-volt lighting circuits protected by the usual 30-amp. fuse. The flame is produced between two parallel carbons or between a single carbon or metal electrode and the material to be welded. A double voltage is supplied; that is, a momentary ionizing current to start the arc and thereafter through an impedance and nichrome ballast to maintain the torch at a constant temperature. The torch

handle is designed to enable the operator to adjust the flame while in operation and to start and stop the arc at will. The torch is primarily designed as a production apparatus on sheet metal and other light parts and for repair work on material up to $\frac{1}{4}$ in.

General Electric Starting-Switch for Fractional-Hp. Motors

A compact starting switch for use when hand-operated control at the motor is required and intended for direct mounting on the built-in terminal box of standard G.E. fractional-horsepower motors, has been developed by the General Electric Co., Schenectady, N. Y. The device is provided with a positive snap-action mechanism and replaces the standard terminal-box cover-plate. It requires no soldering connections or additional wiring. The switch is of the single-pole type, rated 6 amp. at 125 volts or 3 amp. at 250 volts. The specific motors on which the switch can be mounted include the Types KH, KC, RSA; Frames 42, 43, 44, 45, 47, and 49.

THE ROUND TABLE

Profit Motive

"Hello, Al," said Ed, entering his friend's office. "I just got your earnings report for the last quarter. As a stockholder I'm curious to know why we fell below last year."

"I can show you that," said Al, pulling a ledger out of his drawer. "Our volume of business was a little better than 1933, but our costs of doing business went up."

"How can that be?" Ed asked. "You're building the same line of compressors."

"Yes," Al agreed, "but you can see from our books that a greater portion of our income went into taxes, labor and materials. All these increases were caused by government regulation."

"But I thought the government was trying to speed recovery not hinder it."

"No doubt the Administration would like to see business improve," said Al, "but there seems to be a group in Washington that's afraid someone might make a profit. It's that threat to the profit motive that's holding things back right now."

"But isn't the underlying idea to give the worker a greater share of industrial income and thus spread buying power?"

"That's the idea all right, but the method of getting there isn't entirely successful. To increase buying power the nation's gross income must be increased and that can't be done by hampering private enterprise. Most industries are in a delicate balance and anything that makes profits more remote tends to reduce their activity and the amount they are willing to spend. Take this little shop, for instance. If I didn't have a sound design, protected by patents, I doubt whether I could meet my increased costs. I certainly wouldn't undertake to start a shop like this in the face of today's uncertainties. In every line there are concerns whose existence depends on freedom to make money."

"Well, I've seen several statements by Administration spokesmen," said Ed, "where they've claimed the profit motive was essential."

"That's true," said Al, "and I don't believe they aim to make profitable operation impossible. But they've certainly reduced earnings for industries with fixed selling costs like the railroads and the utilities."

"But your prices aren't fixed," said Ed. "There's nothing to keep you from passing the increased cost on to the customer."

"Not all of it, Ed. My customers won't stand for it. I'm willing to pay a fair minimum wage but outside of that I believe the fewer the restrictions and taxes the more prosperous industry will become."

Does current governmental regulation constitute a threat to the profit motive? Is this fear curtailing industrial activity?

Discussion

By the Week

While it is conceivable that the plan employed by Harry Ketchum may work out fairly well in an occasional small plant with carefully picked men of undoubted honesty and loyalty, it would have to be rigidly guarded or the plant would soon become a haven for men with a desire for getting by easily, making the plan no longer fair either to the owner or the loyal employees.

Docking is a form of discipline that is fair when meted out according to a time-clock record. While a time clock may be superfluous in a small shop, it is a necessity in a plant where the management cannot otherwise keep informed as to either the prompt or tardy attendance of the employees.

If there were some way for the management of a large plant to know positively when men were sick or unavoidably detained from work, paying by the week might be a good plan. Unfortunately, there is none, and since an industrial plant can hardly be considered a charitable institution, payment by the week would not always be wise. It does not follow, however, that employees whose record has been good over a period of years cannot be put on a weekly salary basis. —JOHN E. HYLER.

There is no doubt of Al's ability to run his shop on a weekly basis. Time clocks are not necessary, for in the vast majority of small shops work is on the weekly basis, time clocks are dispensed with and there is always a greater spirit of cooperation and friendliness than exists in large shops. Time clocks have the effect of dampening these relations.

On a weekly basis, the individual worker receives approximately the same pay he would receive if he were working by the hour or on piecework, considerable bookkeeping is eliminated, and the firm knows exactly what the pay roll will amount to. The knowledge of regular pay, backed by a friendly firm, brings equal response from the workers in both their output and their interest.

But what about loafers? After all, loafers are to be found in every shop, but under the basis of weekly pay they would be promptly weeded out.

—Will Herman,
Superintendent,
Tanenbaum Oil Company.

In a shop where the workmen are antagonistic and unwilling to cooperate with anybody, time clocks are necessary, and a close tab must be kept on everyone to see that work is never delayed or shirked. But where the employees are anxious to cooperate with the management, or where they are so small in number that detailed checks become absurd, time clocks and snooping inspection can be dispensed with. So long as the general atmosphere is conducive to work, everyone will be a check on everyone else.

There is no reason why employees in a small shop can not be paid a fair week's wage for a fair week's work. Should any slight loss from this source be involved, it will be more than offset by the elimination of costly and troublesome bookkeeping. The plan could never work in a plant employing hundreds or thousands, but for small shops, by the week payment is highly commendable and desirable. —Morry Tanenbaum.

Hourly Pay vs. Piecework

The production of compressors entails methods of precision. As Al's plant is small and the production flow is somewhat uncertain, men of diversified ability must be employed. This means that men will be shifted from one job to another.

In the manufacture of cheap goods where production of parts is large and inspection is not rigid, piecework would be ideal. However, in the small shop building high-class machines, hourly pay would be more fitting. There should, of course, be some requirements as to productivity, the basis for which should be determined either by tryout methods or by time studies. Such a system would aid in production of a uniform quality and would reduce the time necessary for rigid inspection under the piecework system.

There is considerable difference between the production speed-artist and the skilled machine operator. Trying to get more work out of men by the piecework plan may result in sacrificing quality for speed. A good way to speed up production is by employing such machines as are best suited for the job and by better tooling. —Peter L. Budwitz.

Al is right. Good management consists in using the production set-up that utilizes personnel and equipment to the best advantage. In the small shop where work is varied and comes in small lots, a really workable piecework or bonus system is difficult and often costly to install.

In the early days of mass production, when the efficiency of the machine was largely dependent upon the skill of the operator and his ability to resist fatigue, there was some justification for introducing an incentive plan that would make it interesting for the operator. Thus was born the progenitor of the many forms of incentive plans of today—piecework—and right well did it serve its purpose in its day and generation.

But now, with two hours lopped off of the working day and with the trend toward automatic machines becoming greater, production is less regulated by the skill and stamina of the operator; the machine sets the pace. Incentive is now toward the design of more efficient set-up methods and improved tooling, calling for intelligent use of the new high-speed alloys. So it would seem that piecework is on its way out.

—Robert S. Alexander.

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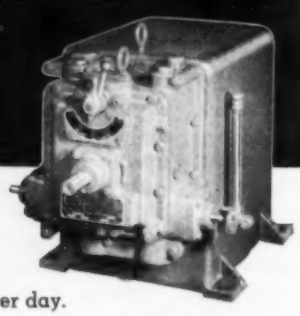

● *Above:* The Foster Fastermatic No. F-4, Oilgear Fluid Power Feed equipped. Makes three parts per hour — best previous time was five per day.

● *At Right:* A new Oilgear Fluid Power Feed. Note: Flanged mounting, as integral machine part . . . Inside pump eliminating hazard and bettering appearance . . . Self-contained; auxiliary valves, tubing, etc. are integral with pump . . . Many other exclusive features.

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